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MUSÉUM D'HISTOIRE NATURELLE
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***Bamanophis*, a new genus for the West African colubrid *Periops dorri* Lataste, 1888 (Reptilia: Squamata: Colubrinae)**

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***Bamanophis*, a new genus for the West African colubrid *Periops dorri* Lataste, 1888 (Reptilia: Squamata: Colubrinae).** - *Bamanophis* gen. n. is a monotypic colubrine genus from the Sahel to Guinea Savanna. It is well defined by external morphology, osteology, and hemipenis features. *B. dorri* (Lataste) shows a variety of scale and skull character states unknown in Afrotropical, Palaearctic, and Saharo-Sindian racers and related genera. Noteworthy are differences in midbody dorsal scale row number frequencies between males and females and significant sexual dimorphism of ventral counts in Senegal. The distribution of Dorr's Racer is reviewed and new locality records from Guinea and Senegal as well as ecological data are presented.

Keywords: *Bamanophis* gen. n. - *B. dorri* (Lataste) - morphology - distribution - W Africa - ecology - systematics - relationships.

INTRODUCTION

Lataste (1888) described Dorr's Racer after two specimens collected at Bakel in eastern Senegal. For the next 80 years or so, there were only three new and precise records from Mali (Angel, 1922; Werner, 1929; Villiers, 1956). Roman (1969, 1980), Hulselmans & Verheyen (1970), and Hughes (1983) reported the species from Burkina Faso, Togo, and Ghana, respectively. Recent fieldwork revealed the presence of Dorr's Racer in Benin, Guinea, and southern Mauritania (Chippaux, 1999; Nickel, 2003; Trape & Baldé, 2006).

Coluber (sensu lato) dorri (Lataste) is outstanding among western Old World racers for various morphological features and only distantly related to Afrotropical, Palaearctic, and Saharo-Sindian genera (Schätti, 1988b; Schätti & Utiger, 2001; Nagy *et al.*, 2004). Apart from *C. scorteccii* Lanza, 1963, this is the only African racer species that has not yet been thoroughly dealt with by the senior author as to its external morphological, osteological, and anatomical (hemipenis) characters and their systematic implications. This study addresses these topics as well as the geographic distribution of Dorr's Racer.

MATERIAL AND METHODS

Twenty specimens (Appendix A) thoroughly analyzed as to pertinent morphological characters were loaned by the following institutions: The Natural History Museum (British Museum [Natural History]), London (BMNH); Museum of Comparative Zoology, Harvard University, Cambridge (MCZ); Muséum National d'Histoire Naturelle, Paris (MNHN); Musée royal de l'Afrique centrale, Tervuren (MRAC); University of Lagos, Department of Zoology, Ghana (ULG); and Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn (ZFMK). Further acronyms used in the text are HLMD (Hessisches Landesmuseum, Darmstadt), IFAN (Institut Fondamental d'Afrique Noire, Dakar), and NMW (Naturhistorisches Museum, Wien [Vienna]). Apart, this paper includes selected data (ventral, subcaudal, and midbody scale row counts, body and tail length) of 96 specimens (including MNHN 1995.9693) from the herpetological collection of the Centre de l'Institut de Recherche pour le Développement (IRD) at Dakar examined by the junior author (Appendix B).

External morphological terms are defined in Schätti (1988b) and Schätti & McCarthy (2004). Numbers in parenthesis indicate intraspecific variation. The dorsal scale row pattern is expressed in terms of ventrals and as a percentage of their total number (%ven) based on the average of the right and left side counts. In most cases, maxillary teeth were examined on the right bone. Vertebra measurements are explained in Auffenberg (1963).

Scientific names of the taxa discussed are usually cited with the author and year only at their first appearance in the text. Coordinates are from the GEONET database (<http://earth-info.nima.mil>), GPS location (Billaouâr, Dar El Oula, Kalekouré, Massamassa, Niamou, Pont Gambie, Tenkoto), or literature and given in the synonymy or the Appendices. For the purpose of this paper, the term Saharo-Sindian is considered of equal rank as the Afrotropical and Palaearctic regions.

RESULTS

Bamanophis gen. n.

Derivatio nominis. The genus is named after the Bamana people from Senegal to northern Ghana and the Greek word *ophis* (οφις), i.e., snake; the gender is masculine.

Diagnosis. Anterior subocular absent [present in other racers]; one comparatively large posterior subocular [smaller]. Ten (eleven) supralabials, fourth and fifth (fifth and sixth) entering eye. Dorsal scales smooth, with paired apical pits; 25-27 longitudinal rows on neck (20th ventral), 29-33 at midbody, 17 (only ♂♂) to 19 prior to anal plate; usually two or three bilateral increases in the number of dorsal scale rows on anterior part of body; reductions after midbody confined to ventrolateral and lateral levels [including paravertebral rows]. 229-265 ventral scales (clear-cut sexual dimorphism in Senegal); tail comparatively short, with 75-95 paired subcaudals. Dark X-shaped markings along the dorsum [pattern different]. 15-19 maxillary teeth, diastema distinct, last tooth laterally offset. Palatine process of maxillary well developed and laterally rounded, lateral process distinct. *Crista basisphenoidea* absent [usually

present]. Hemipenis spinose with intermittent barbed calyces, probably bulbous when everted [sub-cylindrical]. A monotypic genus restricted to western Africa (Sahel to Guinea Savanna).

Apart from characters states indicated in brackets, *Bamanophis* gen. n. differs from Afrotropical, Palaearctic, and Saharo-Sindian racers and related genera in sexually dimorphic midbody and preanal scale rows (number) and from *Hemorrhais*, *Platyceps*, and *Spalerosophis* spp. as well as *Hemerophis socotrae* (condition unknown in *Coluber* [s.l.] *scorteccii* and *C. [s.l.] zebrius*) in osteological characters (maxillary processes, basisphenoid; see Discussion, footnote 6).

***Bamanophis dorri* (Lataste, 1888) – Dorr's Racer¹⁾**

Zamenis florulentus “Dum. et Bib.” [Geoffroy, 1827] [partim]. - Rochebrune, 1884: 162 (Mali: Kita [13°03'N 9°29'W], “Bords du Bakoy [River, ca. 13°03'N 9°45'W], Guellé” [Gouelle, 12°06'N 4°53'W]; Senegal: Bakel; ?“M'Boul”²⁾).

Periops Dorri [sic] Lataste, 1888: 227 - “dans le fort et à côté du fort de Bakel, Haut-Sénégal” (incl. BMNH 1946.1.13.3, see Type Material, Morphology [smallprint], footnotes 1 and 4).

Zamenis [auct.] *dorri*. - Boulenger, 1893: [382, 383] 410 (“Bakel, Upper Senegal”: BMNH specimens [4], see Type Material); Boulenger, 1920: 281 (“Senegal”); Angel, 1922: 39 (Kati [“region caillouteuse de Bélédougou”, Mali]; MNHN 1921.579-583).

Z. [amenis] dorri. - Werner, 1929: [66] 72 (“Bakel, Ob.-Senegal”, Kita [Mali, NMW specimen, leg. A. Weidholz, not examined], see footnote 3).

Zamenis dorri. - Angel, 1933: [645] 713, Figs 36-36a [dorsal and lateral view of head and neck] (“Soudan Français”: incl. MNHN 1922.62, see Morphology [smallprint]).

Coluber dorri. - Dekeyser & Villiers, 1954: 962 (“Peuplement soudanien”); Villiers, 1956: 879 (Mali: “Bamako” [12°39'N 8°00'W, IFAN 54.5.25-26, leg. Chabeuf 1953, not examined]); Villiers, 1963: 110, Fig. 131 [dorsal view of head and neck] (“Mali”); Roman, 1969: 18 (Burkina Faso: vic. Banfora [ca. 10°38'N 4°46'W]).

Coluber dorri [sic]. - Papenfuss, 1969: [285] 305 (“Senegal, Mali”).

Coluber dorri. - Hulselmans & Verheyen, 1970: 200, 202 (Namoundjoga [Togo]: MRAC 29513-14, 29522-23); Villiers, 1975: 111, Fig. 151 [from Villiers, 1963] (“Mali, Haute-Volta, Ghana [without further evidence] et Togo”, see Morphology [smallprint]); Roman, 1980: 99, map (Burkina Faso: Banfora area [Roman, 1969], between Kantchari [12°29'N 1°31'E] and Matiakoali [12°21'N 1°02'E, estimated from map], and south of Namounou [ca. 11°52'N 1°42'E], see Morphology [smallprint]); Joger, 1981: 330, Figs 2 and 6

1) “Boie's racer” as used by Trape (1997) and Trape & Baldé (2006) is a somewhat confusing appellation. Following the original dedication of the species to “M. E. Dorr, capitaine d'infanterie de marine” (Lataste, 1888), Trape & Mané (2006) adopted Dorr's Racer as vernacular name.

2) The ‘Faune de la Sénégalie’ is a curious work. According to Lataste (1888), Rochebrune's (1884) “*Periops paralletus* Dum. et Bib.” [Duméril *et al.*, 1854] is a questionable (“?”) early mention of *Bamanophis dorri*. To conclude from the collection sites and accepted synonymy (e.g., Boulenger, 1893), this reference most certainly refers to *Spalerosophis diadema* (Schlegel, 1837). Instead, “*Zamenis florulentus*” *sensu* Rochebrune (1884) is the very first quotation of Dorr's Racer ever. Certainly, the presence at “Khor Kohl” (Rochebrune, 1884), i.e., Khol (Khor) Khol (15°29'N 15°01'W) in the sandy Ferlo Region, completely devoid of stony areas, is based on a misidentification or confusion of locality. “M'Boul” is a common place name (Mboul) in western Senegal north of 14°N latitude where *Bamanophis dorri* does not occur (Fig. 5). We tentatively map the record as from Mboul (15°48'N 13°13'W) in Mauritania (NW Gorgol) on the Senegal River approximately 180 km downstream from the type locality (Bakel). It cannot be excluded that “M'Boul” is an incorrect spelling for Mbout (15°58'N 12°37'W) in Mauritania.

- [habitat], 15 [photograph: dorsal view of ZFMK 20231] (“W-Mali” [between Negala and Kassaro, “Chutes du Félou” (Félou Falls)]: ZFMK 20231, 22181); Hughes, 1983: 326 [348], Figs 2 and 5 [distribution map, latitudinal range] (N Ghana incl. ca. 11°00'N 0°50'W [estimated from map]; MCZ 67900 [Nakpanduri], ULG 183-84, 190 [Gambaga], see Distribution and Ecology).
- Eremiophis dorri*. - Welch, 1983: 108 (see Discussion [smallprint]).
- Coluber dorri*. - Schätti & Wilson, 1986: 399.1-3 (review).
- C.[oluber] dorri*. - Schätti, 1986: 289 (“schlecht bekannte[r] Arten”); Schätti, 1988b: 111 [footnote 3] (“endemic to interior W Africa”, see Morphology [smallprint]).
- Haemorrhais* [sic] *dorri*. - Meirte, 1992: 69 (checklist, determination key, see Discussion [smallprint]).
- Coluber dorri*. - Joger & Lambert, 1996: 37 [48, 50] (“Mali [...] to northern Ghana”).
- Haemorrhais* [sic] (= *Coluber dorri*). - Trape, 1997: 97 (Senegal: Bandafassi [12°32'N 12°19'W, MNHN 1995.9693], see Discussion [smallprint], footnote 1).
- Haemorrhais* [sic] *dorri*. - Chippaux, 1999: [92] 94, 4 Figs [unnumbered: dorsal and lateral view of head, left maxillary], map 42 [see Fig. 5] (“Du Sénégal au Niger et Bénin”) and Chippaux, 2001: [100] 101 (see Morphology [smallprint]); Trape *et al.*, 2001: Tb. 2 (Bandafassi area, frequency); Trape & Mané, 2002: 149 (checklist).
- Coluber (sensu lato) dorri*. - Schätti & Utiger, 2001: [936] 937 (external morphology, hemipenis, see Discussion).
- Haemorrhais* [sic] (*Coluber dorri*). - Joger & Lambert, 2002: 174 [177, 181], Tbs 3-4 (Senegal: “Tenkoto” [“12°40.38'N 12°16.54'W”], 10 km NW Kédougou [“12°36.57'N 12°14.29'W”]).
- Haemorrhais* [sic] *dorri*. - Nickel, 2003: Tb. 5 [p. 46] (Mauritania [Assaba]: “Guelta Met[r]auch”: [“16°33'48”N 10°45'17”W”, *vide* Padial, 2006]); Trape & Mané, 2004: [5] 17, 31, Figs 1-2 [map, habitat] (Senegal [IRD]: vic. Bandafassi [incl. Ibel, Landiéni, “Nathia” (Natia), Ndébou], Kédougou, see Appendix B).
- Coluber (sensu lato) dorri*. - Nagy *et al.*, 2004: [227, 228] 230, Tbs 1-2, Figs 2-4 (Senegal: “Niokolo-Koba NP” [National Park, HLMD RA-2906], see Discussion).
- Haemorrhais* [sic] *dorri*. - Villiers & Condamin, 2005: 115, Fig. 167 [from Villiers, 1963] (see Morphology [smallprint] and Discussion [smallprint]); Chippaux, 2006: 106, 4 Figs [from Chippaux, 2001], map 42 [see Fig. 5] (see Morphology [smallprint], footnote 5).
- Hemorrhais dorri*. - Padial, 2006: 168 (from Nickel, 2003).
- Haemorrhais* [sic] *dorri*. - Trape & Baldé, 2006: 362 (Guinea: Kalekouré, see Appendix B); Trape & Mané, 2006: [45, 49, 51] 110, 2 Figs [dorsal and lateral view of head], map, 2 [unnumbered] Pls [Mauritania: near Billaouâr, see Fig. 2] (Mali [incl. Bangaya and Koundian (13°10'N 10°41'W, incl. IRD 2364), Niamou, Toumboula (Tomboula, 14°20'N 7°48'W, IRD 2799), see Appendix B]; Mauritania [incl. Dar El Oula (16°35'N 9°48'W, IRD 114), see Fig. 6]).

TYPE MATERIAL

Lataste (1888) described the species on the basis of a subadult (435 mm total length) and adult female (“Deux sujets femelles, un jeune et un adulte”) from Bakel (14°52'N 12°31'W), a French fortress and garrison in the border triangle of Senegal with Mali and Mauritania, below the junction of the Senegal and Falémé Rivers.

Boulenger (1893) did not list preserved material but, surprisingly, gave ventral and subcaudal counts (“245-254” [including preventrals] and “84” [smaller syntype]) not mentioned in the original description of the species, and there is considerable circumstantial evidence to suggest that George A. Boulenger had full access to Fernand Lataste's notes and specimens.

“On his appointment to the posts of Professor of Zoology and Assistant-Director of the Museum in Santiago, Chili, in 1889, M. Lataste felt reluctantly compelled to abandon his projected Catalogue of the Reptiles and Batrachians of Barbary. He handed over to me the whole of his notes, with the request that I should bring out the work. The constant correspondence with

my distinguished friend ever since he took up the study of that fauna, as well as my acquaintance with his collection, had prepared me for such a work [...]" (Boulenger, 1891: 93).

There is no clear indication how long the Lataste collection, and in particular the type specimens of *Bamanophis dorri*, had been in Boulenger's care. Probably, the lion's share was shipped to London before Lataste's departure to Chile in 1889 but the collection as a whole was not formally presented to the 'British Museum' at that time. This perhaps reflected Lataste's hope to work on his specimens in the future and made him consider a formal donation as premature then. By 1920, short of a realistic prospect to resurrect his endeavour, and Boulenger only months away from retirement, the decision seemed finally to have been made to register Lataste's specimens into the BMNH herpetological collection, using the prefix "1920.1.20" followed by the donor's own registration number. Thus, BMNH 1920.1.20.3742 (now 1946.1.13.3) and 1920.1.20.3785 (1946.1.14.82, not examined), the syntypes of *Periops dorri* Lataste, were integrated together with two additional topotypical specimens, i.e., BMNH 1920.1.20.4074 (not examined) and 1920.1.20.4085 (Colin McCarthy *in litt.*).

MORPHOLOGY

Head rather distinct from neck and with a broadly rounded snout; 2.37-2.83 times longer than wide. Rostral 2.0-2.62 times broader than high, hardly projecting between the internasals; the latter about the same length as, or slightly shorter than, the prefrontals. Frontal slightly bell-shaped, much wider anteriorly; 1.25-1.44 times longer than broad, 1.09-1.31 times longer than internasals and prefrontals, 0.83-1.07 times as long as parietals; lateral borders noticeably concave in BMNH 1920.1.20.4085. Posterior border of parietals usually distinctly indented, forming a >-shaped angle from the postero-lateral edge to the median suture in, e.g., BMNH 1946.1.13.3 [syntype], MNHN 1921.579, 1922.62, 1937.57-58, MRAC 29513-14 and 29523; shape of lateral borders variable.

Nasal divided; distance from the nostril to the eye 0.86-0.98 times the length of the internasals and prefrontals. Loreal rectangular or sub-trapezoidal and distinctly longer than high, wedged in the lower part of the preocular; below touching posterior border of second and third (sometimes also anteriormost part of fourth) supralabial. Preocular single, upper portion much broader, in contact with frontal or not. Anterior subocular absent. Normally ten supralabials, eleven in MNHN 1921.582 and on left side of MNHN 1922.62; ninth (tenth) or posterior three or four largest. Fourth (upper posterior edge) and fifth (fifth and sixth) supralabial in contact with eye. Two postoculars (upper larger); with a well-defined posterior subocular below, precluding sixth and seventh (sixth to eighth) supralabial from bordering eye. IRD 177 has a small upper portion of the sixth supralabial detached on the left side, i.e., two posterior suboculars and only one (fifth) supralabial entering eye.

Lataste (1888) is incorrect in that various suboculars were present in the syntypes (see Discussion). Angel (1933) is mistaken in his statement regarding as few as nine supralabials, the third and fourth bordering the eye (see also Villiers, 1963, 1975), and the occurrence of three postoculars mentioned by these authors and others (e.g., Chippaux, 1999 etc.; Villiers & Condamin, 2005) is not supported by our data. Two well-defined posterior suboculars (instead of the situation as in IRD 177 with a detached part of a supralabial) as shown in Angel (1933: Fig. 36a, unidentified specimen) have never been observed in the material examined for this

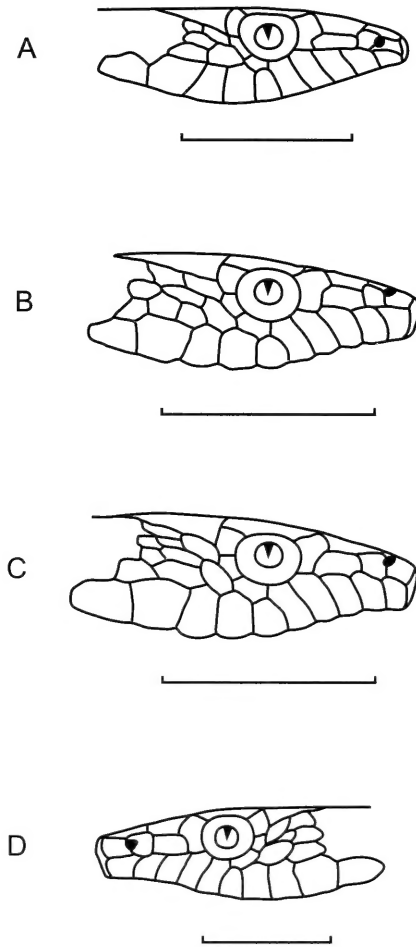


FIG. 1

Lateral head view of *Bamanophis dorri* MCZ 67900 (A), MRAC 29513 (B), MRAC 29522 (C), and MRAC 29523 (D). Line equals 10 mm. Drawings by Heidi Laubscher and Andrea Stutz.

study (see smallprint below). Roman (1980) is wrong that the species is characterized by a complete row of suboculars separating the upper labials from the eye (“sous-oculaires qui séparent l’œil des labiales”). Schätti’s (1988b: footnote 3) comment regarding the lack of “a subocular” in *Bamanophis dorri* referred to the absence of an anterior (!) subocular. Trape & Mané (2004, 2006) stated that there was no subocular at all (“pas de sous-oculaire”) because they regarded this scale as the lowest of three postoculars.

Usually 2+3 temporals in first and second row; lower anterior temporal normally larger than upper and in contact with seventh and eighth (eighth and ninth) supralabial; three scales in first row on left side of BMNH 1946.1.13.3 [syntype], MNHN 1921.582, and ZFMK 20231; four in second row of MNHN 1921.582 (left), MNHN 1922.62 (right), and MRAC 29522 (both sides). Size, shape, and configuration of anterior temporals fairly variable (Fig. 1).

Contrary to Lataste (1888) and Boulenger (1893: “three anterior temporals”), the larger syntype (BMNH 1946.1.13.3) has two scales in the first row on the right side. Angel’s (1933: Fig. 36a) illustration of the temporal scalation is hardly realistic (see smallprint above). This is also the case with Chippaux’ (1999 etc.) drawings; the dorsal and lateral head view simply do not correspond, and two second temporals as shown in the latter’s figures have not been reported by us. Trape & Mané (2004) found 2+3 anterior temporals in 126 out of 142 cases (71 specimens); the remaining counts are 2+4 (1), 3+3 (10), and 3+4 (5).

Ten to twelve sublabials, the four or five anterior in contact with first chin shield, sixth or seventh (or both) largest. Anterior and posterior pair of chin shields about equal in length and width (anterior broader in BMNH 1920.1.20.4085, 1946.1.13.3 [syntype], MNHN 1922.62, and ZFMK 22181, and shorter in MRAC 29514 and 29523). Posterior chin shields usually separated by two (none or one in some specimens) rows of normally partially concealed small scales anteriorly and usually two (three, rarely one) scales behind. Three to four (five) oblique rows of gulars between the posterior chin shields and the first ventral.

Ventrals distinctly angulate laterally (i.e., with conspicuous keels), 229-265 ($\delta\delta$ 229-248, $\text{♀}\text{♀}$ 242-265) in examined specimens (Appendices A and B); anal scute divided; 75-95 ($\delta\delta$ 76-88, $\text{♀}\text{♀}$ 75-95) paired subcaudals; sum of ventrals and subcaudals 308-360 ($\delta\delta$ 308-333, $\text{♀}\text{♀}$ 320-360).

Boulenger (1893) gave 254 ventrals (including at least one preventral) and 84 subcaudals for the subadult syntype (BMNH 1946.1.14.82, not examined, see Type Material). Angel’s (1922) mention of 231 ventrals is based on MNHN 1921.581 from Mali, a damaged and somewhat desiccated specimen; the complete number of ventrals is higher but difficult to be precisely determined.

Based on 74 specimens from the Bandafassi area (SE Senegal), Trape & Mané (2004) found significant sexual dimorphism in the number of ventrals. This is true for Senegal as a whole, i.e., males have fewer (229-242) ventrals than females (243-260). In Mali, however, the separation is less marked (236-248, 244-265)³.

Subcaudal counts of males (76-88) and females (75-87) from Senegal are virtually identical. Females from Mali show a surprisingly wide range for subcaudal counts, i.e., 76-95 ($\delta\delta$ 80-86), and the maximum for the sum of ventrals and subcaudals (360) is definitely higher than in females from Senegal (343).

Dorsal scales smooth and subequal (first lateral row enlarged), with paired apical pits. Paravertebral rows enlarged in MRAC 29522 and ZFMK 20231. In 25-27 longitudinal rows (dsr) on neck, 29-33 at midbody (msr), and 17 ($\delta\delta$) or 19 (δ , $\text{♀}\text{♀}$) in front of the anal scute. Scale formulae of seventeen specimens (Tb. 1) 25-29-17 (2 $\delta\delta$), 25-31-17 (4 $\delta\delta$), 25-31-19 (δ , 4 $\text{♀}\text{♀}$), 25-33-19 (♀), 27-31-19 (2 $\text{♀}\text{♀}$), or 27-33-19 (δ , 2 $\text{♀}\text{♀}$).

MRAC 29523 (♀) has 27-25-27 dsr from ventral 21 to 26 (averages of right and left side, changes involving rows 5-6) and an increase to 21 immediately prior to the vent (ventral 248, 99%ven) comprising rows 2-3. MNHN 1921.579 (♀) with irregular number (27-26-27) between ventrals 28 and 36 (rows 4-5). MNHN 1922.62 (δ , right side) and ZFMK 20231 (♀ , left) with alternation of 31-30-31 dsr between ventrals 99 and 105 (41.1-43.6%ven, rows 6-8) and 78-83 (32.0-34.0%ven, rows 6-7), respectively.

³ For this reason, the gender of Werner’s (1929) juvenile from Kita (“junges Exemplar”, not examined) with “248” ventrals (including one or two preventrals, 84 subcaudals) remains unknown for the time being.

TABLE 1. Dorsal scale row pattern of *Bamanophis dorri*. Accession number, sex, formula (number of transverse dorsal rows at 20th ventral, midbody [50%-ven] and five ventrals prior to the vent), reduction levels (above: dorsal scale rows involved; below: longitudinal position in percent of total number of ventrals, see Material and Methods), and comment (see text regarding bold figures in the case of BMNH 1946.1.13.3, MCZ 67900, MNHN 1921.579, 1922.62, 1937.58, MRAC 29523, and ZFMK 20231). Blanks do not apply.

Accession no.	sex	formula	25-27	27-29	29-31	31-33	33-31	31-29	29-27	27-25	25-23	23-21	21-19	19-17	comment
MCZ 67900	♂	25-31-17	?	7+8	7-9		7+8	5+6	5-7	4+5	3-5	3+4	3+4	3+4	
MNHN 1921.580	♂	25-31-17	?	22.7	37.3		57.7	61.2	63.4	66.5	70.3	81.8	96.2	96.2	
MNHN 1921.582	♂	27-33-19	?	?	?	?	?	?	?	?	?	?	?	?	no further data
MNHN 1921.583	♂	25-31-17	?	?	?	?	?	?	?	?	?	?	?	?	badly damaged
MNHN 1922.62	♂	25-31-17	4-6	6+7	6+7		7+8	5, 7	6-8	4-6	4+5	3+4	3+4	3+4	damaged
MNHN 1937.58	♂	25-29-17	?	20.8	25.5		57.9	59.3	61.4	63.1	66.6	73.4	93.0	93.0	no further data
MRAC 29513	♂	25-31-19	6+7	6+7	7+8		7+8	?	?	5+6	5+6	4+5	4+5	4+5	
ULG 190	♂	25-29-17	?	?	43.0		54.1	6-8	6+7	5+6	4+5	3+4	4+5	4+5	
BMNH 1920.1.20.4085	♀	25-31-19	5+6	5-8	6-8		58.0	60.8	65.2	68.6	78.7	96.6			
BMNH 1946.1.13.3	♀	27-31-19	16.5	21.1	35.7		55.8	59.8	62.3	65.5	71.5	89.0			syntype
MNHN 1921.579	♀	27-31-19	?	19.1	23.8		59.4	61.4	65.0	68.5	79.7	89.6			
MNHN 1937.57	♀	25-31-19	4+5	6-8	6+7		56.1	59.8	61.8	64.9	68.6	80.4			
MRAC 29514	♀	25-31-19	5+6	6+7	6+7		51.4	57.4	60.5	62.3	67.3	83.9			badly damaged
MRAC 29522	♀	27-33-19	18.1	6-8	6-8		7+8	5+6	5-7	4+5	4+5	3-5	3-5	3-5	
29523	♀	27-33-19		18.8	23.1		58.3	60.7	63.4	68.4	77.5	91.5			
ZFMK 20231	♀	25-33-19	4+5	6+7	6-8		7+8	6+7	6+7	4 [+4]	4+5	3+4	3+4	3+4	
ZFMK 22181	♀	25-31-19	16.2	21.3	30.5		58.8	61.0	63.6	68.2	78.0	90.6			no further data

All ninety examined specimens from Senegal have 29 or 31 msr (Tb. 2); the adult syntype (1946.1.13.3, ♀) shows partly 32 dsr at ventrals 110-120. A majority of males (65%) has 29 msr whereas all females except IRD 1975 (29) have 31 (see also Trape & Mané, 2004). In Mali, both sexes usually show 31 msr. The highest counts (33) were found in five individuals from Mali and Togo.

TABLE 2. Number of midbody dorsal scale rows (msr) in *Bamanophis dorri*. Data from 114 specimens (see Appendices A and B) and three additional Senegalese females, i.e., the subadult syntype BMNH 1946.1.14.82 (Boulenger, 1893), IRD 1972 (Bandafassi), and IRD 3053 (Ibel).

	29 msr		31 msr		33 msr	
	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
Senegal (48 ♂♂, 42 ♀♀)	31 65%	1 2.5%	17 35%	41 97.5%		
Mali (10 ♂♂, 10 ♀♀)	2 20%		7 70%	8 80%	1 10%	2 20%
Ghana, Togo (3 ♂♂, 3 ♀♀)	1 - 33%		2 66%	1 33%		2 66%

Two or three (four in ZFMK 20231) bilateral increases in the number of dsr between ventrals 30 and 103 (13.5-43.0%ven) in males and 39-106 (16.2-41.8%ven) in females involving rows 4-9. Six or seven bilateral reductions confined to ventrolateral and lateral levels, i.e., the first three involving rows 4-9, the fourth rows 3-7, and the last two or three rows 3-6 (Tb. 1). Males have the anterior three reductions at ventrals 125-155 (54.1-65.2%ven), and the fourth to last at 152-230 (63.1-96.6%ven). In females, the values are 123-161 (51.2-65.0%ven) and 159-232 (62.3-91.5%ven), respectively. Reduction to 17 dsr in six out of eight males (not observed in females) between ventrals 223 and 230 (93.0-96.6%ven). Two males (MCZ 67900, MNHN 1937.58) restore 19 dsr immediately prior to the vent, i.e., at ventrals 235 and 238 (99.2-99.6%ven), respectively.

Longest male (IRD 15) slightly over 810 (665 + 145) mm (tip of tail missing); females attain up to 995 (800 + 195) mm (IRD 11). Smallest individuals 233 (187 + 46) mm (♂, IRD 2955) and 251 (206 + 45) mm (♀, IRD 4255), respectively. Tail/body ratio 0.21-0.26 (♂♂) and 0.18-0.24 (♀♀).

Dorsal colouration beige, greyish, light brown, or pale reddish ("lie de vin": Lataste, 1888). Head usually with irregular but symmetrical dark brown markings on pileus, in particular the supraoculars, frontal, and parietals (faint in large individuals). Supralabials speckled with brown. Nuchal spot with a median line projecting to the posterior end of the parietal suture (see, e.g., Angel, 1933: Fig. 36; Villiers, 1963, 1976: Fig. 151; Trape & Mané, 2006: [unnumbered] Pl.). A dorsal series of approximately 40-50 dark brown X-shaped markings, small light round paravertebral ocelli enclosed at the base of the acute angle of the lateral branches, and a mediolateral series of juxtaposed brownish spots. Irregular paraventral small brown or grey spots may occur. Dorsal colour pattern of juveniles definitely more developed and richer in contrast.



FIG. 2

Bamanophis dorri (♂, IRD 180) from the vicinity of Billaouâr (16°30'N 10°46'W), Mauritania.

Body below white, sometimes with a yellowish tinge, or reddish ("rosé"), uniform throughout or with small brownish speckles along lateral edges of ventrals.

Maxillary with 15-19 subsodont teeth; last two separated by a usually quite distinct diastema and enlarged, last tooth offset laterad; palatine process well developed and laterally rounded, lateral process distinct (Chippaux, 1999 [etc.]: Figs). Palatine 9, pterygoid 16-17, dentary 17 teeth (MCZ 69700 [palatine], MNHN 1922.62). Transverse ridges of basisphenoid separated, i.e., *crista basisphenoidea* absent (Fig. 3, see footnote 6). Length of midbody vertebra centrum divided by least width of neural arch 1.20-1.29, length of centrum / width across prezygapophyses between outer edge of articular facets 0.64-0.67, and length of neural crest / least width of neural arch 0.88-0.92 (MNHN 1937.57).

The *in situ* hemipenis of MCT 67900 reaches the 13th subcaudal (16%sub). The organ is spinose with intermittent barbed calyces (Fig. 4) and probably comparatively corpulent when everted.

DISTRIBUTION AND ECOLOGY

Dorr's Racer is reported from southern Mauritania (Assaba, Gorgol [see footnote 2], Hodh El Gharbi), eastern Senegal, parts of Guinea, southern Mali, and Burkina Faso to the northern parts of Ghana (in particular Northern and Upper East Region), Togo, and Benin (Fig. 5). Most probably, *Bamanophis dorri* occurs in the north of Ivory Coast as well as in SW Niger and NW Nigeria (see Hughes 1983: 348).

According to Joger (1981), *Bamanophis dorri* appears ("scheint") to be an endemic of the hilly Sudan Savanna between the Upper Senegal and Middle Niger

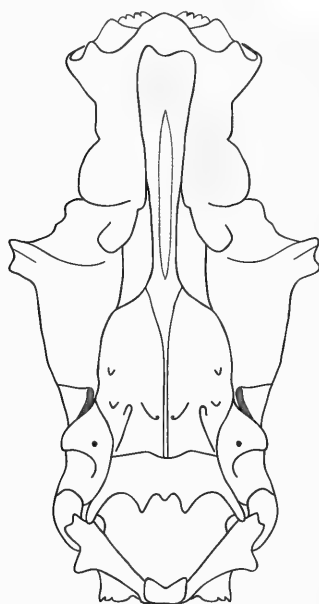


FIG. 3

Neurocranium (ventral view) of MRAC 29523. Drawing by Andrea Stutz.

Rivers (“Endemit der hügeligen Sudansavanne zwischen dem oberen Senegal und dem mittleren Niger”). Joger & Lambert (1996) “localised” the species “in wooded savanna” from Mali to N Ghana. Also considered “a typical representative of the Sahelian fauna” (Nagy et al., 2004: 230), Dorr’s Racer in reality is widely distributed in open Guinea Savanna (Trape & Mané, 2006). IRD 646-G from the “wet savannah area” (Kalekouré) near Kindia (Trape & Baldé, 2006) is the record nearest to the Guinea Forest belt. Joger & Lambert (2002: 181) attributed the absence of the species “in western and central Senegal [...] to ecological [...] reasons.”, i.e., the lack of suitable habitats.

Bamanophis dorri is rupicolous, found in a variety of habitats including rubble areas, rocky outcrops, cliffs, and ravines. In Senegal, the species seems to be closely associated with rocky debris (Trape & Mané, 2004: Fig. 2). Joger & Lambert (2002) reported Dorr’s Racer from “man-made structures (among wall blocks) adjacent to woodland”. One of the syntypes had been collected within the fortress of Bakel (Lataste, 1888). In Mali, Millet-Horsin collected five specimens (MNHN 1921.579-583) in the stony plain of “Bélédougou” near Kati (Angel, 1922). Joger (1981: Figs 2 and 6) found the species at night in rocky situations (“in felsiger Umgebung”), i.e., among dry leaf cover on a hill in open dry forest (ZFMK 20231) and on a plateau near Medine (Félou Falls), south-west of Kayes (ZFMK 22181). MCZ 67900 from Nakpanduri (N Ghana) was collected in open Guinea Savanna.

The type locality (Bakel) approximately 25 m above sea level is the lowest elevation reported for Dorr’s Racer. The species is probably present at altitudes higher

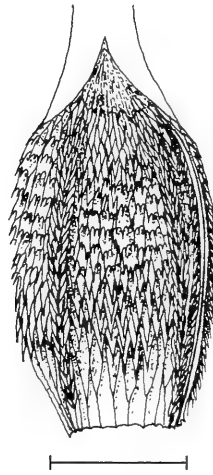


FIG. 4

Left *in situ* hemipenis of MRAC 29513. Line equals 5 mm. Drawing by Heidi Laubscher and Andrea Stutz.

than 600 m in the Mandingues Mountains (ca. 12°35'N 8°10'W), Mali. In the Fouta Djallon (Futa Jallon, ca. 11°30'N 12°30'W) of N Guinea, rocky formations usually inhabited by *Bamanophis dorri* are found up to over 1'000 m a.s.l. Four specimens from Togo (MRAC series) are from ca. 200 m a.s.l.

This is an alert and agile species of usually crepuscular or nocturnal activity; during the cooler season, particularly in the northern part of the distribution range, Dorr's Racer is also active during daytime (Trape & Mané, 2006).

The two syntypes of *Bamanophis dorri* were found on 3rd and 4th June (Lataste, 1888). ZFMK 20231 and 22181 were taken in January and March, respectively, MCZ 67900 on Christmas day, and the MRAC series end of July (Hulselmans & Verheyen, 1970). MNHN 1995.9693 from Bandafassi was obtained on 28th December (Trape, 1997), and two specimens from SE Senegal in mid-October (Joger & Lambert, 2002). The photographed specimen from Mauritania (Fig. 2) was collected soon after sunset on 11th October 2005. IRD 44 was encountered in January or February.

Bamanophis dorri preys on lizards (11 cases) and rodents (2, Trape & Mané, 2004). Out of 105 specimens (all from eastern Senegal) examined as to their food items, 76 turned out negativ (plus one not identified); five contained remains of rodents; twenty-three had fed on lizards (*Agama* spp. [4], *Hemidactylus* spp. [12], scincids [4] including *Trachylepis* spp., lacertids [3]); one case of ophiophagy (juvenile *Psammophis elegans* Shaw, 1802) was recorded. MNHN 1921.581 had an *Agama agama* Linnaeus, 1758 in its stomach. Another MNHN specimen from the vicinity of Kati was found about to swallow an "*Agama colonorum*" (*A. agama* Linn.) of such size that the oesophagus got split ("de telle taille [...] qu'une éventration s'est produite ver le milieu du tube digestif", Angel, 1933). A single female was encountered gravid, i.e., IRD 2374 (date of capture unknown) with two eggs measuring 16-18 mm in length and 8 mm thick.

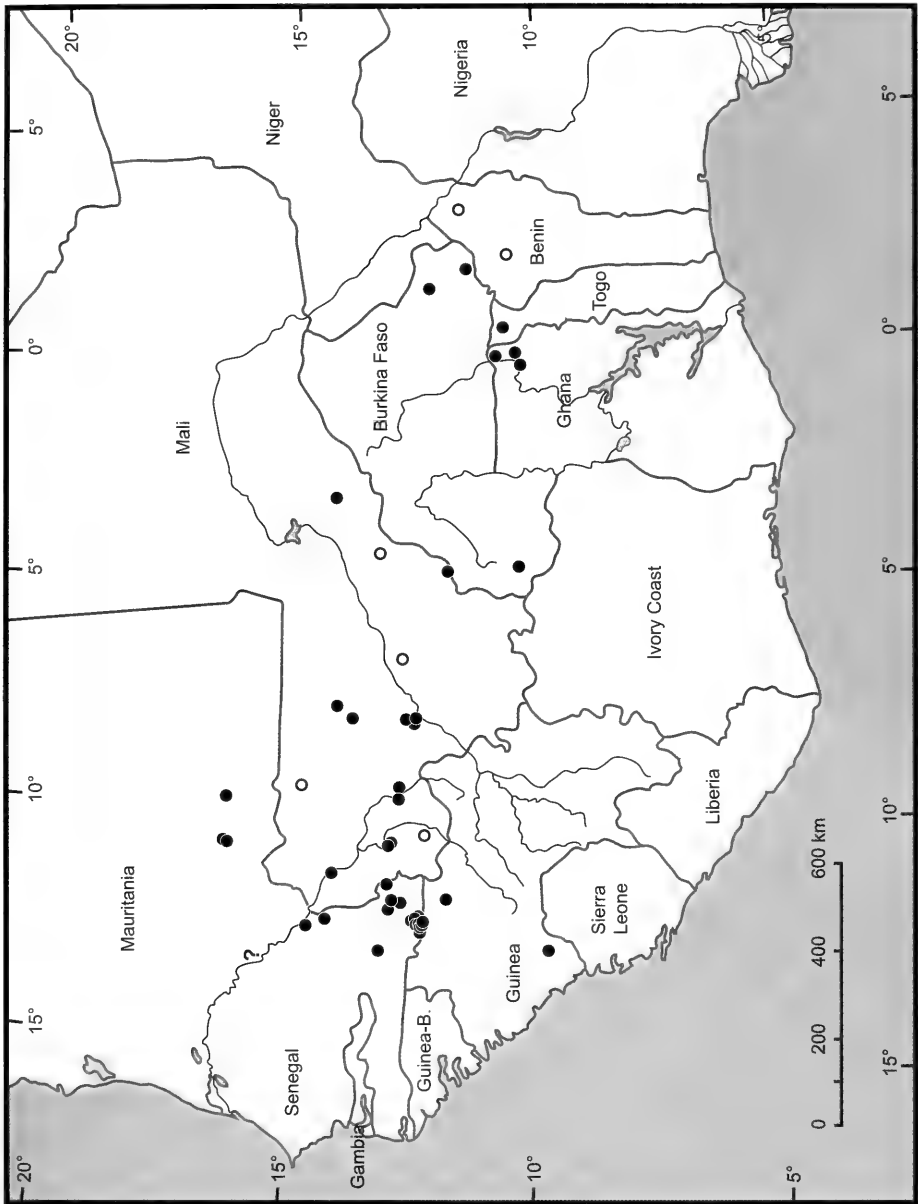


FIG. 5. Distribution of *Bamanophis dorri* based on examined material (Appendices A and B), literature records (Rochebrune, 1884; Villiers, 1956; Roman, 1969, 1980; Hughes, 1983; Joger & Lambert, 2002; Nickel, 2003), and four localities based on IRD specimens not examined for the purpose of this study from N Guinea (Pont Gambie: 12°00'N 11°49'W, IRD 3530-G) and Senegal (IRD 5558, 5684, 5687, 6409, 6750-52), i.e., Bellé (14°25'N 12°18'W), Ségou (12°25'N 12°17'W), and Wassandara (13°13'N 11°33'W). Open circles indicate six approximate collecting sites (unspecified records) in N Benin and Mali from Chippaux (1999, 2006: map 42). The question marks denotes Mboul, Mauritania (see footnote 2). Drawing by Andrea Stutz.

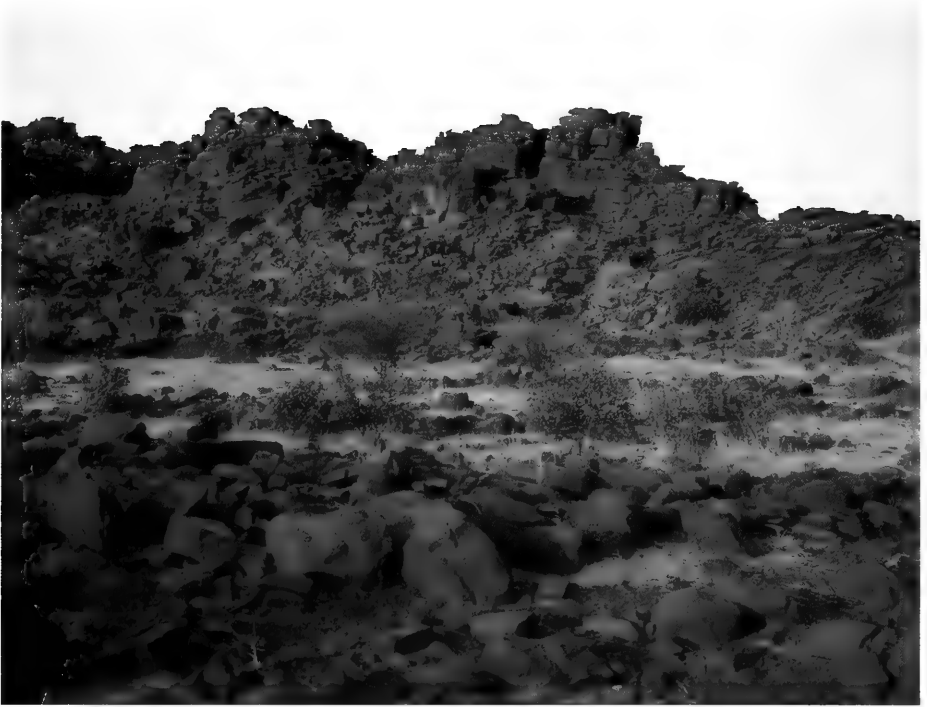


FIG. 6

Eroded sandstone habitat of *Bamanophis dorri* in the southern Affolle Mountains (Hodh El Gharbi) near Dar El Oula (16°35'N 9°48'W), Mauritania (photograph taken in April 2005).

In the Bandafassi area (SE Senegal), *Bamanophis dorri* accounts for 5,8% of all snakes collected (Trape & Mané, 2004), thus the species is at least locally abundant (74 specimens). The sex ratio in the examined material (Appendices A and B) is 61 (♂♂) to 52 (♀♀). Information regarding the sympatric herpetofauna is found in, for instance, Joger & Lambert (1996, 2002) and Trape & Mané (2004).

DISCUSSION

Lataste (1888) assigned Dorr's Racer to *Periops* Wagler, 1830, an objective synonym (same type species: *Coluber hippocrepis* Linn.) of *Hemorrhoids* Boie, 1826 (Schätti, 1986). This genus is made up of the Western Mediterranean (particularly NW African) *H. algirus* (Jan, 1863) and *H. hippocrepis* (Linnaeus, 1758), and two species (*nummifer*, *ravergieri*) from the eastern Mediterranean to Central Asia and Pakistan⁴.

⁴ As to the systematic scope of *Periops* Wagler, Lataste (1888) relied on Jan (1863). The 'Elenco' also includes *P.[eriops] parallelus* (syn. *Spalerosophis diadema*, see footnote 2) with, for instance, advanced fragmentation of the lateral head scales (Schätti & McCarthy, 1987). *Hemorrhoids algirus* and *H. hippocrepis* often have the preocular divided and always two or more suboculars. Ultimately, Lataste (1888) allocated Dorr's Racer to *Periops* auct. because of similar proportions ("par les proportions générales"), above all the distinct separation of the head from

Boulenger (1893) included Dorr's Racer in the hotchpotch *Zamenis* auct. before Dekeyser & Villiers (1954) formally assigned the species to *Coluber* auct., another systematic jumble and actually a Nearctic genus. *Eremiophis* Fitzinger, 1843 (Welch, 1983) is a *nomen dubium* (Schätti, 1987: footnote 2, 1988a, 1993a). By and large, Meirte (1992) followed Welch's (1982) concept for African racers. The latter author referred all taxa known to him to "*Haemorrhais* Boie 1826" (actually, *Periops dorri* Lataste is missing in this highly deficient and obsolete compilation). "*Haemorrhais* (= *Coluber*) *dorri*" (Trape, 1997; Joger & Lambert, 2002) is based on these two "authorities" (see also, e.g., Chippaux, 1999 etc.; Villiers & Condamin, 2005; footnote 5). This spelling is Boie's (1827) unjustified emendation of *Hemorrhais* Boie, 1826 (Schätti, 1988a; Williams & Wallach, 1989).

Lataste (1888) averred that the single preocular scale of *Bamanophis dorri* excludes ("écarte") Dorr's Racer from *Hemorrhais* and *Spalerosophis* spp. (i.e., *Periops* auct.). Zoogeographic considerations, i.e., the mainly Palaearctic distribution ("les espèces [...] ne sont authentiquement connues que de la région paléarctique, descendant tout au plus (*Periops parallelus*) jusque dans le Sahara", see footnotes 2 and 4) further nurtured his doubts regarding the relationships of Dorr's Racer. The intrinsic problem with Lataste's (1888) generic allocation is that he was incorrect in his statement regarding the alleged presence of various (!) suboculars ("présence de sous-oculaires") in *B. dorri*; this declaration is made in the introduction and not confirmed by the text of the descriptive part ("Dix sus-labiales, les quatrième et cinquième bordant l'oeil"). If he had not committed that error, Lataste (1888) probably would have come to a different conclusion as he clearly contemplated a new genus for Dorr's Racer ("on pourra penser que l'espèce décrite ici donnerait également lieu à la création d'un genre nouveau"). Instead, he anticipated Boulenger's (1893 [etc.]) revision of snake genera in the "Catalogues of the British Museum" and, as *ad interim* measure ("provisoirement"), assigned the new species to *Periops* auct. (see Type Material, footnote 4).

Based on scale features and hemipenis ornamentation, Schätti & Utiger (2001: 937) concluded that Dorr's Racer may be only distantly related to African racers, in particular *Hemorrhais* spp. and those of the genus *Platyceps* Blyth, 1860. Without taking into account the enigmatic *Coluber [sensu lato] scorteccii* Lanza, 1963 from Somalia, these two genera include all except two geographically isolated African species, i.e., *Hemerophis socotrae* (Günther, 1881), a monotypic genus from the Sokotra islands, and the yet unassigned *Coluber [s.l.] zebrinus* Broadley & Schätti, 1999 from arid SW Africa. Based on nucleotide sequences, and in accordance with the long isolation of the archipelago from the African continent, *H. socotrae* branched off from a hypothetical ancestral stock prior to the radiation leading to recent Old World racer genera discussed in this paper (Schätti & Utiger, 2001: Figs 8-9; Utiger *et al.*, 2005: Fig. 3). Molecular (mtDNA) data also demonstrate that *C. [s.l.] zebrinus* belongs to a lineage that diverged prior to the evolution of Afrotropical, Palaearctic, and Saharo-Sindian racers and related genera; its sequence divergence (*p*) vis-à-vis *H. socotrae* is 14,5% (Schätti & Charvet, 2003; Schätti & Monsch, 2004).

the neck, the scalation ("l'écaillage"), in particular ("notamment") the presence of "suboculars" (in contradiction with the description), a large number ("le grand nombre") of supralabials and dorsal scale rows, as well as distinctly keeled ventrals and even ("voire meme") its overall colour pattern ("son système de coloration"), i.e., similarities in the irregular head markings on the vertex and the basic arrangement of the dorsal pattern ("la disposition élémentaire du dessin").

According to Nagy *et al.* (2004: 227), “*Coluber* s.l. *dorri*” is a member of “the most basal” clade of “Old World racers” including “*C. s.l. zebrinus*” and *Macroprotodon cucullatus* (Geoffroy, 1827) (see also Lawson *et al.*, 2005), the “sister taxon” to Dorr’s Racer. Their separation from the common ancestor “was likely brought about by the emerging Sahara desert”, and the subsequent evolution of grooved posterior teeth in *Macroprotodon* Guichenot, 1850 “has little bearing on phylogeny” but “precludes the inclusion of *dorri* in that genus”⁵).

The absence of an anterior subocular and paravertebral dorsal scale row reductions, sexually dimorphic reduction features (number of midbody and preanal scale rows), and the hemipenis (at least the shape) morphologically separate *Bamanophis* from Afrotropical, Palearctic, and Saharo-Sindian racers and their allies discussed in this paper, i.e., *Coluber* [s.l.] *zebrinus*, *Hemerophis socotrae*, and *Hemorrhoids*, *Platyceps*, and *Spalerosophis* spp.⁶). Based on the drawings in Chippaux (1999 etc.), the maxillary of *B. dorri* differs from, for instance, *H. hippocrepis* and *H. socotrae* in the form of the palatine and lateral processes (Schätti, 1993b: Fig. 24; Schätti & Utiger, 2001: Fig. 3).

Potentially ancestral (plesiomorphic) character states shared by the new genus and *Macroprotodon* include, for instance, the lack of an anterior subocular and paravertebral scale reductions (“Exceptionally” present in *Macroprotodon*; Wade, 2001). The latter differs from *Bamanophis* in a variety of characters including lateral head scales (e.g., posterior subocular [absent in *Macroprotodon*], number of temporals), midbody dorsal scale rows (19-23 [25] vs. 29-33), dentition (opisthoglyph vs. aglyph, and position of the diastema), and skull features such as, e.g., the situation of the Vidian foramen (Underwood, 1967: 112) (Wade, 1988, 2001).

A more detailed understanding of the phylogenetic relationships of the monotypic genera *Bamanophis* and *Macroprotodon* vis-à-vis other colubrine clades requires further morphological and molecular investigations including sub-Saharan genera. By all means, a “Palearctic [sic] origin” of Dorr’s Racer as asserted by Papenfuss (1969) is in need of confirmation.

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⁵ Discussing the results of Nagy *et al.* (2004), Chippaux (2006) concluded that Dorr’s Racer should be placed (“devrait appartenir”) in *Macroprotodon*. However, the former authors clearly stated that their molecular data “indicate a considerable independent phylogenetic history for each of these taxa.”

⁶ The separation of the transverse ridges of the basisphenoid in the *area centralis* (Fig. 3) distinguishes Dorr’s Racer from *Hemorrhoids*, *Platyceps*, and *Spalerosophis* spp. (see Schätti, 1987: Fig. 1). The *crista basisphenoidea* is weakly developed in *Hemerophis socotrae* (Schätti & Utiger, 2001: Fig. 5). The condition in *Coluber* [s.l.] *zebrinus* is unknown (this is also the case with hemipenis characters). Vertebra ratios of *Bamanophis dorri* are close to those observed in *Hemorrhoids* spp. (Schätti, 1987: Tb. 1, Fig. 2).

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REFERENCES

- ANGEL, F. 1922. Sur une collection de reptiles et de batraciens, recueillis au Soudan français par la mission du Dr Millet Horsin. *Bulletin du Muséum d'Histoire naturelle de Paris* 1922 (1): 39-41.
- ANGEL, F. 1933. Les Serpents de l'Afrique Occidentale Française. *Bulletin du Comité d'Études historiques et scientifiques de l'Afrique Occidentale Française* XV (4) [1932]: 613-858.
- AUFFENBERG, W. 1963. The fossil snakes of Florida. *Tulane Studies in Zoology* 20: 131-216.
- BLYTH, E. 1860. Report of Curator, Zoological Department. *Journal of the Asiatic Society of Bengal* 29 (1): 87-115.
- BOIE, F. 1826. Generalübersicht der Familien und Gattungen der Ophidier. *Isis [Oken]* 19 (10): 981-982.
- BOIE, F. 1827. Bemerkungen über Merrem's Versuch eines Systems der Amphibien. *Isis [Oken]* 20 (6): 508-566.
- BOULENGER, G. A. 1891. Catalogue of the Reptiles and Batrachians of Barbary (Morocco, Algeria, Tunisia) based chiefly upon the Notes and Collections made in 1880-1884 by M. Fernand Lataste. *Transactions of the Zoological Society of London* XIII (3): 93-164.
- BOULENGER, G. A. 1893. Catalogue of the snakes in the British Museum (Natural History). Vol. 1. *London, Trustees of the British Museum (Natural History)*, XIII + 448 pp.
- BOULENGER, G. A. 1920. A list of the snakes of West Africa, from Mauritania to the French Congo. *Proceedings of the Zoological Society of London* 1919 (III): 267-298.
- BROADLEY, D. G. & SCHÄTTI, B. 1999. A new species of *Coluber* from northern Namibia (Reptilia: Serpentes). *Madoqua* 19 (2) [1997]: 171-174.
- CHIPPAUX, J. P. 1999. Les serpents d'Afrique occidentale et centrale [Collection Faune et Flore tropicales 35]. *Paris, Institut de Recherche pour le Développement [IRD]*, 278 pp.
- CHIPPAUX, J. P. 2001. Les serpents d'Afrique occidentale et centrale [2nd ed.]. *Paris, IRD*, 292 pp.
- CHIPPAUX, J. P. 2006. Les serpents d'Afrique occidentale et centrale [3rd ed.]. *Paris, IRD*, 311 pp.
- DEKEYSER, P. L. & VILLIERS, A. 1954. [Notes et Documents] Essai sur le peuplement zoologique terrestre de l'Ouest africain. *Bulletin de l'Institut Français d'Afrique Noire [A]* XVI (3): 957-970.
- DUMÉRIL, A. M. C., BIBRON, G. & DUMÉRIL, A. 1854. Erpétologie générale ou histoire naturelle complète des reptiles. Vol. 7 (I). *Paris, Roret*, XVI + 780 pp.
- FITZINGER, L. 1843. Systema Reptilium. Amblyglossae. *Vindobonae [Vienna], Braumüller & Seidel*, 106 + VI [+ 3] pp.
- GEOFFROY [SAINT-HILAIRE], I. 1827. Description des reptiles qui se trouvent en Égypte (pp. 121-160). In: SAVIGNY, J. C. Description de l'Égypte ou recueil des observations et des recherches qui ont été faites en Égypte pendant l'expédition de l'armée française (1798-1801). I. Histoire naturelle, Part 1. *Paris, Imprimerie Impériale*.
- GUICHENOT, A. 1850. Histoire naturelle des reptiles et des poisons. Part 3. In: Exploration scientifique de l'Algérie pendant les années 1840, 1841, 1842. Zoologie. *Paris, Bibliothèque Française*, 144 pp. [not seen, *vide* Wade, 2001].
- GÜNTHER, A. 1881. Descriptions of the amphisbaenians and ophidians collected by Prof. I. Bayley Balfour in the Island of Socotra. *Proceedings of the Zoological Society of London* 1881 (II) (30): 461-463.

- HUGHES, B. 1983. African snake faunas. *Bonner zoologische Beiträge* 34 (1-3): 311-356.
- HULSELMANS, J. L. J. & VERHEYEN, W. N. 1970. Contribution à l'herpétologie de la République du Togo. 2. Liste préliminaire des Serpents récoltés par la deuxième Mission zoologique belge au Togo. *Revue de Zoologie et de Botanique Africaines* LXXXII (1-2): 200-204.
- JAN, G. 1863. Elenco sistematico degli ofidi descritti e disegnati per l'Iconografia generale. *Milano, A. Lombardi*, VII + 143 pp.
- JOGER, U. 1981. Zur Herpetofaunistik Westafrikas. *Bonner zoologische Beiträge* 32 (3-4): 297-340.
- JOGER, U. & LAMBERT, M. R. K. 1996. Analysis of the herpetofauna of the Republic of Mali. 1. Annotated inventory, with description of a new *Uromastix* (Sauria: Agamidae). *Journal of African Zoology* 110: 21-51.
- JOGER, U. & LAMBERT, M. R. K. 2002. Inventory of amphibians and reptiles in SE Senegal, including the Niokola-Koba National Park, with observations on factors influencing diversity. *Tropical Zoology* 15: 165-185.
- LANZA, B. 1963. Il genere *Coluber* in Somalia e descrizione di una nuova specie. *Atti della Società Italiana di Scienza Naturale e del Museo Civico di Storia Naturale, Milano* 102 (IV): 379-396.
- LATASTE, F. 1888. Description d'un Ophidien diacrantérien nouveau (*Periops Dorri*, n. sp.) originaire du Haut-Sénégal. *Le Naturaliste* [2] 10 (38): 227-228.
- LAWSON, R. SLOWINSKI, J. B., CROTHER, B. I. & BURBRINK, F. T. 2005. Phylogeny of the Colubroidea (Serpentes): New evidence from mitochondrial and nuclear genes. *Molecular Phylogenetics and Evolution* 37: 581-601.
- LINNAEUS, C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis, Vol. 1 (editio decima, reformata). *Holmiae [Stockholm], L. Salvii*, IV + 823 [+ 1] pp.
- MEIRTE, D. 1992. Clés de détermination des serpents d'Afrique. *Annales du Musée Royal de l'Afrique Centrale, Sciences Zoologiques* 267: 1-152.
- NAGY Z. T., LAWSON, R., JOGER, U. & WINK, M. 2004. Molecular systematics of racers, whip-snakes and relatives (Reptilia: Colubridae) using mitochondrial and nuclear markers. *Journal of Zoological Systematics and Evolutionary Research* 42 (3): 223-233.
- NICKEL, H. 2003. Ökologische Untersuchungen zur Wirbeltierfauna im südöstlichen Mauretanien. Zwei Fallstudien unter besonderer Berücksichtigung der Krokodile. *Eschborn, Deutsche Gesellschaft für Technische Zusammenarbeit*, 89 pp.
- PADIAL, J. M. 2006. Commented distributional list of the reptiles of Mauritania (West Africa). *Graellsia* 62 (2): 159-178.
- PAPENFUSS, T. J. 1969. Preliminary analysis of the reptiles of arid Central West Africa. *The Wasmann Journal of Biology* 27 (2): 249-325.
- ROCHEBRUNE, A. T. DE 1884. Faune de la Sénégambie. IV. Reptiles. *Paris, O. Doin* [4 vols in one].
- ROMAN, B. 1969. Serpents de Haute-Volta. *Ouagadougou, Presses Africaines* [22 sheets in folder].
- ROMAN, B. 1980. Serpents de Haute-Volta. *Ouagadougou, C.N.R.S.T.*, 129 pp.
- SCHÄTTI, B. 1986. Systematik nordafrikanischer Zornnattern aus der Verwandtschaft von *Coluber algirus* und *C. hippocrepis*. *Bonner zoologische Beiträge* 37 (4): 281-293.
- SCHÄTTI, B. 1987. The phylogenetic significance of morphological characters in the Holarctic racers of the genus *Coluber*. *Amphibia-Reptilia* 8 (4): 401-418.
- SCHÄTTI, B. 1988a. Systematik und Evolution der Schlangengattung *Hierophis* Fitzinger, 1843. *Zürich, [unpublished] Ph. D. thesis*, 50 pp.
- SCHÄTTI, B. 1988b. Systematics and phylogenetic relationships of *Coluber florulentus* (Reptilia, Serpentes). *Tropical Zoology* 1 (1): 95-116.

- SCHÄTTI, B. 1993a. *Coluber* Linnaeus, 1758 – Zornnattern (pp. 69-73). In: BÖHME, W. (ed.), *Handbuch der Reptilien und Amphibien Europas*. Band 3/I. Wiesbaden, Aula-Verlag, 479 pp.
- SCHÄTTI, B. 1993b. *Coluber hippocrepis* Linnaeus, 1758 – Hufeisennatter (pp. 115-130). In: BÖHME, W. (ed.), *Handbuch der Reptilien und Amphibien Europas*. Band 3/I. Wiesbaden, Aula-Verlag, 479 pp.
- SCHÄTTI, B. & CHARVET, C. 2003. Systematics of *Platyceps brevis* (Boulenger 1895) and related East African racers (Serpentes Colubridae). *Troical. Zooogy*. 16 (1): 93-111.
- SCHÄTTI, B. & MCCARTHY, C. 1987. Relationships of the snake genera *Pythonodipsas* Günther and *Spalerosophis* Jan. *Bonner zoologische Beiträge* 38 (4): 265-268.
- SCHÄTTI, B. & MCCARTHY, C. 2004. Saharo-Arabian racers of the *Platyceps rhodorachis* complex – description of a new species (Reptilia: Squamata: Colubrinae). *Revue suisse de Zoologie* 111 (4): 691-705.
- SCHÄTTI, B. & MONSCH, P. 2004. Systematics and phylogenetic relationships of Whip snakes (*Hierophis* Fitzinger) and *Zamenis andreana* Werner, 1917 (Reptilia: Squamata: Colubrinae). *Revue suisse de Zoologie* 111 (2): 239-256.
- SCHÄTTI, B. & UTIGER, U. 2001. *Hemerophis*, a new genus for *Zamenis socotrae* Günther, and a contribution to the phylogeny of Old World racers, whip snakes, and related genera (Reptilia: Squamata: Colubrinae). *Revue suisse de Zoologie* 108 (4): 919-948.
- SCHÄTTI, B. & WILSON, L. D. 1986. *Coluber*. *Catalogue of American Amphibians and Reptiles* 399: 1-4.
- SCHLEGEL, H. 1837. *Essai sur la physionomie des serpens*. Vol. 2 [Partie descriptive]. *La Haye, Kips & Van Stockum*, 606 + XV [+ 1] pp.
- SHAW, G. 1802. *General zoology or systematic natural history*. Vol. 3 (2) [Amphibia]. *London, G. Kearsley*, VI [+2] + 615 pp.
- TRAPE, J.-F. 1997. Geographic Distribution. *Haemorrhhois* (= *Coluber*) *dorri* (Boie's racer). *Herpetological Review* 28 (2): 97-98.
- TRAPE, J.-F. & BALDÉ, C. 2006. Geographic Distribution. *Haemorrhhois dorri* (Boie's racer). *Herpetological Review* 37 (3): 362.
- TRAPE, J.-F. & MANÉ, Y. 2002. Les serpents du Sénégal: liste commentée des espèces. *Bulletin de la Société de Pathologie Exotique* 95 (3): 148-150.
- TRAPE, J.-F. & MANÉ, Y. 2004. Les serpents des environs de Bandafassi (Sénégal oriental). *Bulletin de la Société Herpétologique de France* 109: 5-34.
- TRAPE, J.-F. & MANÉ, Y. 2006. *Guide des serpents d'Afrique occidentale, Savane et désert*. Paris, IRD, 226 pp.
- TRAPE, J.-F., PISON, G., GUYAVARCH, E. & MANÉ, Y. 2001. High mortality from snakebite in south-eastern Senegal. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 95: 420-423.
- UNDERWOOD, G. 1967. A contribution to the classification of snakes. Publication 653. *London, Trustees of the British Museum (Natural History)*, 179 pp.
- UTIGER, U., SCHÄTTI, B. & HELFENBERGER, N. 2005. The Oriental colubrine genus *Coelognathus* Fitzinger, 1843 and classification of Old and New World racers and ratsnakes (Reptilia, Squamata, Colubrinae, Colubrinae). *Russian Journal of Herpetology* 12 (1): 39-60.
- VILLIERS, A. 1956. La collection de serpents de l'I.F.A.N. (Acquisitions 1954-1955). *Bulletin de l'Institut Français d'Afrique Noire* [A] XVIII (3): 877-883.
- VILLIERS, A. 1963. Les Serpents de l'Ouest Africain [2nd ed.]. *Dakar, Institut Français d'Afrique Noire* [Initiations Africaines no. II], 190 pp.
- VILLIERS, A. 1975. Les Serpents de l'Ouest Africain [3rd ed.]. *Dakar, Institut Fondamental d'Afrique Noire* [Initiations et Études Africaines no. II], 195 pp.
- VILLIERS, A. & CONDAMIN, M. 2005. Les Serpents de l'Ouest Africain [4th ed.]. *Dakar, Université Cheikh Anta Diop*, 205 pp.
- WADE, E. 1988. Intraspecific variation in the colubrid snake genus *Macroprotodon*. *Herpetological Journal* 1: 237-245.

- WADE, E. 2001. Review of the False Smooth snake genus *Macroprotodon* (Serpentes, Colubridae) in Algeria with a description of a new species. *Bulletin of the Natural History Museum, Zoology Series*, 67 (1): 85-107.
- WAGLER, J. 1830. Natürliches System der Amphibien mit vorangehender Classification der Säugethiere und Vögel. *München, Stuttgart und Tübingen, J. G. Cotta*, VI + 354 pp.
- WELCH, K. R. G. 1982. Herpetology of Africa. A checklist and bibliography of the orders Amphisbaenida, Sauria and Serpentes. *Malabar, Krieger*, X + 293 pp.
- WELCH, K. R. G. 1983. A comment on the generic allocation of the Old World species of the genus *Coluber*. *Litteratura Serpantium* [English ed.] 3 (4): 104-110.
- WERNER, F. 1929. Übersicht der Gattungen und Arten der Schlangen aus der Familie Colubridae. III. Teil (Colubrinae). Mit einem Nachtrag zu den übrigen Familien. *Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere* 57(1/2): 1-196.
- WILLIAMS, K. L. & WALLACH, V. 1989. Snakes of the world. Vol. I. Synopsis of snake generic names, *Malabar, Krieger*, VIII + 234 pp.

Appendix A

Bamanophis dorri examined for the purpose of this study. GHANA: MCZ 67900 (Nakpanduri, 10°38'N 0°11'W, ♂); ULG 183-184 ("Ghana", juveniles; only maxillary teeth counts), 190 (Gambaga, 10°32'N 0°27'W, ♂). MALI: MNHN 1921.579-583 (vicinity of Kati, 12°45'N 8°04'W, 3 ♂♂, ♀♀, leg. Millet-Horsin), 1922.62 ("Haut-Sénégal Niger", ♂, leg. Fertelle), 1937.57-58 (Falaises de Bandiagara [B. Cliffs], 14°25'N 3°19'W, ♂♀, leg. de Ganay); ZFMK 20231 (between Negala and Kassaro, 12°55'N 8°40'W, ♀), 22181 ("Chutes du Félou" [F. Falls, south-west of Kayes], 14°21'N 11°21'W, ♀). SENEGAL: BMNH 1920.1.20.4085 (Bakel, 14°52'N 12°31'W, subad. ♀), 1946.1.13.3 (Bakel, ♀ syntype). TOGO: MRAC 29513 [field tag 1167] and 29514 [1168], 29522 [1184] and 29523 [1187] (Namoundjoga, 10°53'N 0°24'E, ♂, 3 ♀♀, coll. Verheyen *et al.*).

Appendix B

IRD specimens of *Bamanophis dorri* (sex, number of ventrals, subcaudals, and midbody scale row counts; a plus sign [+] denotes an incomplete tip of tail. An asterisk (*) indicates new locality record). GUINEA. *Kalekouré* (9°55'N 12°48'W): 646-G (? , 243, -, -). MALI. *Bangaya* (13°14'N 10°43'W): 1 (♀, 259, 84, 31), 9 (♀, 262, 93, 31), 11 (♀, 265, 95, 31), 14 (♂, 245, 86, 31), 15 (♂, 238, 86, 31), 19 (♀, 264, 83, 31), 23 (♂, 248, 80, 31), 26 (♂, 237, 83, 29), 28 (♀, 260, -, 31), 31 (♂, 247, 86, 31). *Niamou* (14°01'N 8°03'W): 44 (♀, 249, 80, 33). SENEGAL. *Bandafassi* (12°32'N 12°19'W): 163 [now MNHN 1995.9693] (♂, 232, -, 31), 1951 (♂, 238, 83, 29), 1974-75 (♀♀, 253, -, 31; 258, 78, 29), 1982 (♂, 230, 80, 29), 1985 (♀, 245, 79, 31), 1993-94 (♂♂, 234, 83, 29; 239, 83, 31), 2537 (♀, 252, 87, 31), 2540 (♂, 236, 79, 29), 2545 (♀, 251, 75, 31), 2562 (♀, 254, 72+, 31), 2588 (♂, 240, 88, 29), 2594 (♂, 242, 76, 29), 2629 (♀, 242, 79, 31), 4347 (♂, 241, 87, 29), 4357 (♀, 250, 81, 31), 4378 (♂, 232, 85, 31). **Gamon* (13°20'N 12°55'W): 4632 (♀, 247, 79, 31). *Ibel* (12°31'N 12°23'W): 1755 (♀, 257, 83, 31), 1762 (♂, 237, 84, 29), 1769 (♂, 233, 86, 29), 1772 (♂, 233, 85, 29), 1775 (♀, 252, 84, 31), 1777 (♂, 240, 88, 31), 1783 (♀, 252, 80, 31), 1785-86 (♂♀, 231, 81, 29; 253, -, 31), 1793 (♂, 237, 82, 31), 2902 (♂, 240, 85, 31), 2907 (♂, 235, 81, 29), 2917-18 (♂♀, 231, 83, 29; 245, 87, 31), 2922 (♀, 256, 82, 31), 2924 (♂, 235, 83, 31), 2927 (♀, 248, 82, 31), 2934-35 (♂♂, 238, 82, 29; 237, 81, 29), 2938 (♀, 259, 84, 31), 2951 (♂, 235, 84, 31), 2955 (♂, 234, 83, 31), 2957 (♂, 235, 84, 31), 2962 (♂, 234, 83, 29), 2994 (♂, 235, 82, 29), 2998-99 (♀♀, 250, 78, 31; 253, 79, 31), 3003 (♀, 251, 78, 31), 3007 (♀, 250, -, 31), 3009 (♂, 240, 81, 29), 3039 (♀, 242, 87, 31), 3044 (♂, 240, 81, 29), 3073 (♂, 238, 83, 29), 3085 (♀, 245, 78, 31), 3089-90 (♂♂, 240, 78, 29; 239, 84, 29), 4161 (♂, 232, 82, 29), 4178 (♀, 248, 78, 31), 4206 (♂, 235, 79, 31), 4232 (♂, 236, 85, 29), 4235 (♂, 234, 81, 29), 4255-56 (♀♀, 246, 81, 31; 256, 85, 10), 4261 (♂, 233, 82, 29). *Kédougou* (12°33'N 12°11'W): 1733 (♂, 229, 79, 29). *Landiéni* (12°33'N 12°22'W): 1871 (♀, 249, 79, 31), 1876 (♀,

245, 78, 31), 1911 (♂, 234, 81, 31), 2112 (♂, 237, 81, 31), 2373-76 (4 ♀♀, 253, 83, 31; 250, 82, 31; 253, 80, 31; 247, -, 31), 2378 (♂, 232, 83, 29), 2380-81 (♂♀, 234, 80, 29; 249, 78, 31). **Mamakono* (13°11'N 12°03'W): 4501 (♂, 231, 85, 31). **Massamassa* (12°55'N 11°55'W): 4543 (♂, 231, 81, 31), 4580 (♀, 244, 80, 31). **Natia* (12°28'N 12°21'W): 2682 (♀, 250, 76+, 31), 2743 (♂, 231, 79, 31), 2751 (♂, 230, 83, 29), 2823 (♀, ?, 76, 31). **Ndébou* (12°31'N 12°26'W): 3266 (♂, 242, 85, 29). **Sambarabougou* (13°07'N 11°51'W): 5454 (♂, 233, 84, 31).

Two new yellow-legged species of *Hybos* Meigen from Hainan, China (Diptera, Hybotidae)

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Two new yellow-legged species of *Hybos* Meigen from Hainan, China (Diptera, Hybotidae). - Six yellow-legged species of the genus *Hybos* are reported from Hainan. The following two new species are described, illustrated and compared with morphologically similar species: *Hybos bawanglingensis* sp. n. and *H. hainanensis* sp. n. A key to the six species of the genus from Hainan is presented for the first time.

Keywords: Diptera - Hybotidae - *Hybos* - new species - Hainan.

INTRODUCTION

Within the Hybotidae *Hybos* Meigen is characterized by the following traits: long spine-like proboscis, anal cell longer than basal cell, Rs rather short, R_{4+5} and M_1 divergent apically (Chvála, 1983; Yang & Yang, 2004). It is distributed worldwide with 164 known species (Yang *et al.*, 2007). The species of *Hybos* from China were revised by Yang & Yang (2004) who mentioned 85 known species. The major references dealing with *Hybos* in the Old World are Brunetti (1920), Frey (1953), Smith (1965), Saigusa (1963, 1965), Chvála (1983), Yang & Yang (2004), and Yang *et al.* (2006).

Hainan Island with a tropical climate belongs to South China. It is famous for its rich biodiversity. Up to now, only two *Hybos* species, *H. jianfengensis* Yang, Yang & Hu, 2002 and *H. particularis* Yang, Yang & Hu, 2002, have been described from this region (Yang *et al.*, 2002; Yang & Yang, 2004). In the present paper, four yellow-legged species of *Hybos* are added to the fauna of Hainan. Two species are described as new to science. A key to the species of the genus from Hainan is presented for the first time.

MATERIAL AND METHODS

The specimens for this study are deposited in the following collections:

CAU Entomological Museum of China Agricultural University, Beijing, China.

MHNG Muséum d'histoire naturelle, Genève, Switzerland.

Basic terminology follows McAlpine (1981) and Steyskal & Knutson (1981). The following abbreviations are used: acr = acrostichal, ad = anterodorsal, av = anteroventral, d = dorsal, dc = dorsocentral, h = humeral, npl = notopleural, oc = ocellar, pd = posterodorsal, presc = prescutellar, psa = postalar, pv = posteroventral, v = ventral.

KEY TO SPECIES (MALES) OF *HYBOS* FROM HAINAN

1. Legs mostly yellow; arista bare or pubescent 2
 Legs mostly or entirely black; arista bare 5
2. Thoracic pleuron black; scutellum black 3
 Thoracic pleuron yellow; scutellum yellow
 *flaviscutellum* Yang & Yang, 1986
3. Hind tibia with 1 strong ad at middle; arista pubescent at least on basal 3/4 . 4
 Hind tibia without distinct ad; arista bare *hainanensis* sp. nov.
4. Left and right surstyli hook-like; hypandrium with a large apical inci-
 sion *serratus* Yang & Yang, 1992
 Left and right surstyli not hook-like; hypandrium with a narrow cleft
 apically *bawanglingensis* sp. nov.
5. Legs entirely black; wing pale grayish brown
 *jianfengensis* Yang, Yang & Hu, 2002
 Legs partly yellow; wing hyaline *particularis* Yang, Yang & Hu, 2002

TAXONOMIC PART

Hybos bawanglingensis sp. n.

Figs 1-4

MATERIAL: Holotype male, Hainan, Bawangling, Donger, 25. V. 2007, Junhua Zhang (CAU).

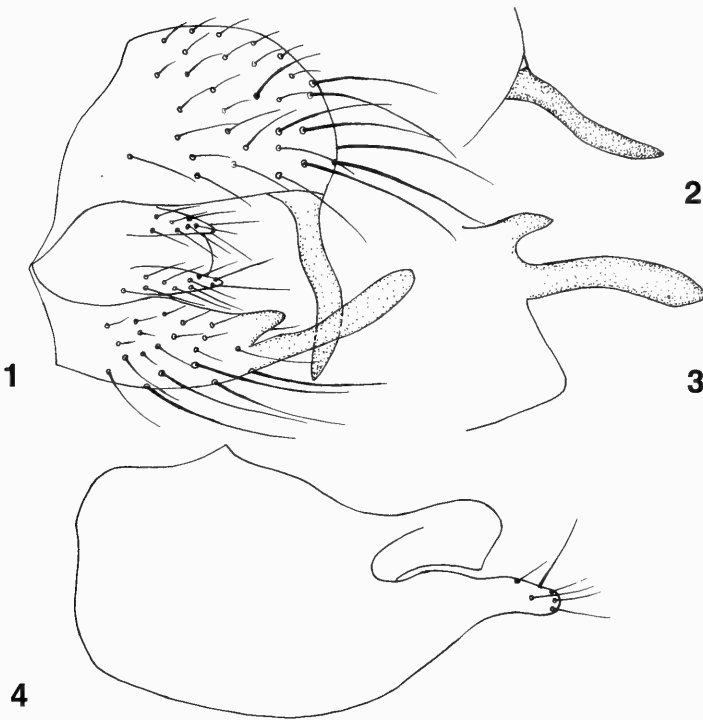
ETYMOLOGY: The species is named after the type locality Bawangling.

DIAGNOSIS: Legs yellow except tarsomeres 3-5 black. Hind tibia with 1 ad at middle. Hypandrium with a narrow cleft apically.

DESCRIPTION: MALE. Body length 4.2 mm, wing length 3.8 mm.

Head: black, pale gray microtrichose. Eyes dark brown but enlarged upper facets brownish yellow, contiguous on frons. Setae and setulae on head black; ocellar tubercle weak, with one pair of long oc and 2 very short posterior setulae. Antenna black; scape bare; pedicel with a circle of subapical setulae; first flagellomere black without dorsal setulae; arista black, short pubescent except apical 1/4 thin and bare. Proboscis black; palpus black with 1 long ventral setula apically.

Thorax: black, pale grey microtrichose. Setae and setulae on thorax black; post-pronotal lobe with black setulae; h absent, 2 npl (anterior npl short), acr in about 6 more or less regular rows, 1 distinct posterior dc and 8 setulae anteriorad, 1 long presc, 1 long psa; scutellum with 6 marginal setulae and 2 long subapical setae. Legs yellow; hind femur dark yellow dorsally, hind knee dark brown, hind tibia dark yellow basally; tarsomeres 3-5 dark brown. Setae and setulae on legs black. Fore femur 1.1 times as wide as mid femur, with one row of setulae-like pv nearly as long as femur thickness; hind femur 1.9 times as wide as mid femur, with 3 preapical anterior setae, and with one row of 9 v and 6 av which are spine-like and inserted on weak tubercles. Fore tibia with 1 long d at middle, apically with 1 long ad; mid tibia with 2 long ad on basal half and 1 very long av at middle, apically with 5 setae of which 1 av is very long; hind tibia with 1 long ad at middle, apically with 1 av and pd. Fore tarsomere 1 with 1 v at base; mid tarsomere 1 with 2 v on basal 2/5, apically with 1 ad and 1 pv; hind tarso-



FIGS 1-4

Hybos bawanglingensis sp. n. (male). (1) genitalia, dorsal view. (2) right surstylus. (3) left surstylus. (4) hypandrium, ventral view.

mere 1 with 2 v at base. Wing slightly tinged with grayish; stigma dark brown; veins dark brown, R_{4+5} and M_1 divergent apically. Squama dark yellow, bordered with pale setulae. Halter brownish.

Abdomen: nearly straight, black, grey microtrichose. Setulae on abdomen black. Male genitalia (Figs 1-4): left epandrial lobe narrow, left surstylus with a short and a long process closely located; right epandrial lobe wide, right surstylus with a long spine-like process strongly curved inward; hypandrium distinctly longer than wide, basally wide and nearly truncate, apically narrow and with a narrow cleft.

FEMALE: Unknown.

DISTRIBUTION: China (Hainan).

REMARKS: The new species is very similar to *Hybos gutianshanus* Yang & Yang from Zhejiang and Guangdong, but can be easily separated from the latter by having the hind femur with 3 preapical anterior setae, the hind tibia with 1 ad at middle, and the hypandrium narrowly cleft apically with the right lobe long and narrow apically. In *H. gutianshanus*, the hind femur has 4 preapical anterior setae, the hind tibia has 2 ad at middle, and the hypandrium is widely cleft apically with the right lobe wide and obtuse apically (Yang & Yang, 2004).

Hybos hainanensis sp. n.

Figs 5-8

MATERIAL: Holotype male, Hainan, Wuzhishan, Jingguantai-Zhumanguzhai, 18. V. 2007, Kuiyan Zhang (CAU). Paratypes: 1 male, 1 female, Hainan, Wuzhishan, Shuimanxiang, 15. V. 2007, Jie Zeng (CAU). 6 males, 6 females, Hainan, Diaoluoshan, Baishuiling, 1-2. VI. 2007, Jingxian Liu (CAU, MHNG).

ETYMOLOGY: The species is named after the type locality Hainan.

DIAGNOSIS: Arista bare. Legs yellow except hind knee and base of hind tibia blackish and tarsomeres 3-5 dark brown. Left epandrial lobe with 4 long strong spines

DESCRIPTION: MALE. Body length 3.0-3.8 mm, wing length 2.8-3.8 mm.

Head: black, pale gray microtrichose. Eyes dark brown but enlarged upper facets brownish yellow, contiguous on frons. Setae and setulae on head black; ocellar tubercle weak, with one pair of long oc and 2 very short posterior setulae. Antenna black; scape bare; pedicel with a circle of subapical setulae; first flagellomere black without long seta (but with 1 subapical long seta in 1 paratype); arista black, bare. Proboscis blackish; palpus black with 1 long ventral setula apically.

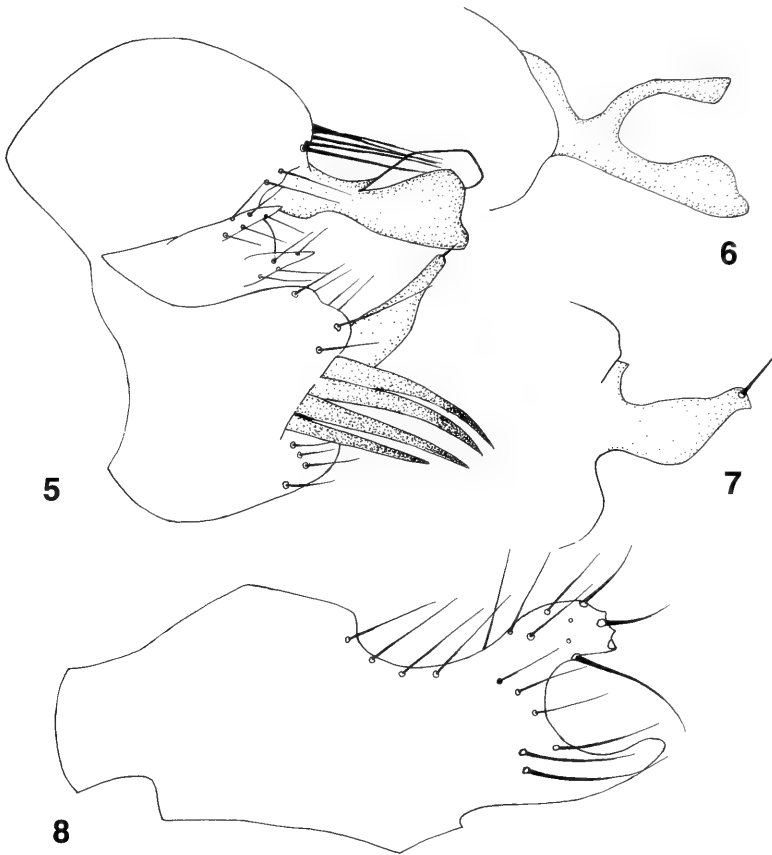
Thorax: black, pale grey microtrichose. Setae and setulae on thorax black; post-pronotal lobe with black setulae; h absent, 2 npl (anterior npl short), acr in about 6 more or less regular rows, 1 distinct posterior dc and 8 setulae anteriorly, 1 long presc, 1 long psa; scutellum with 6 marginal setulae and 2 long subapical setae. Legs yellow, but base of hind tibia including knee blackish and tarsomeres 3-5 dark brown. Setae and setulae on legs black. Fore femur 1.2 times as wide as mid femur, with one row of long setula-like pv distinctly longer than femur thickness; mid femur with one row of setula-like av and pv nearly as long as femur thickness; hind femur 2.7 times as wide as mid femur, with 3 preapical dorsal setae, and with one row of 15 v and 7 av which are spine-like and inserted on weak tubercles. Fore tibia with 1 long ad at middle and one row of very long setula-like pv (longer than pv on fore femur), apically with 1 long ad; mid tibia with 1 very long ad at basal 1/3, 1 short ad at apical 1/3 and 1 very long av at middle, apically with 4 setae (1 av very long); hind tibia without ad but with a long setula at middle, apically with 1 av and 1 pd. Fore tarsomere 1 with long setula-like pv; mid tarsomere 1 with 1 v at basal 1/3; hind tarsomeres 1 with 2 very short ventral spines on basal 1/3. Wing hyaline; stigma dark brown; veins dark brown, R_{4+5} and M_1 divergent apically. Squama dark yellow, bordered with pale setulae. Halter pale yellow.

Abdomen: nearly straight, black, grey microtrichose. Setulae on abdomen black. Male genitalia (Figs 5-8): left epandrial lobe wide with one row of 4 long strong spines, left surstylus curved, more or less tapering toward tip, with 1 seta at extreme tip; right epandrial lobe wide, right surstylus deeply bifurcated apically; hypandrium much longer than wide, basally slightly narrow, apically furcated.

FEMALE: Body length 3.0-3.9 mm, wing length 3.0-3.7 mm. Similar to male.

DISTRIBUTION: China (Hainan).

REMARKS: The new species is very particular. It can be easily separated from other known species of the genus by the left epandrial lobe with 4 long strong spines.



FIGS 5-8

Hybos hainanensis sp. n. (male). (5) genitalia, dorsal view. (6) right surstylus. (7) left surstylus. (8) hypandrium, ventral view.

***Hybos flaviscutellum* Yang & Yang, 1986.**

Hybos flaviscutellum Yang & Yang, 1986: 81. Type locality: China: Guangxi, Longsheng.

MATERIAL: 1 male, Hainan, Bawangling, Donger, 24. V. 2007, Junhua Zhang (CAU).

DISTRIBUTION: China (Zhejiang, Guangxi, Hainan).

***Hybos serratus* Yang & Yang, 1992.**

Hybos serratus Yang & Yang, 1992: 1089. Type locality: China: Sichuan, Xichang.

MATERIAL: 1 male, Hainan, Bawangling, Donger, 24. V. 2007, Kuiyan Zhang (CAU).

DIATRIBUTION: China (Henan, Sichuan, Guizhou, Guangxi, Hainan).

ACKNOWLEDGEMENTS

My sincere thanks are due to Dr. Junhua Zhang and Ms. Kuiyan Zhang (China Agricultural University, Beijing) and Mr. Jingxian Liu and Ms. Jie Zeng (South Agricultural University, Guangzhou) for collecting the specimens, and to Dr. B. Merz (Muséum d'histoire naturelle, Genève) for reviewing an earlier draft of this manuscript. The research was funded by the National Natural Science Foundation of China (No. 30770259, No. 30225009) and the Ministry of Science and Technology of the People's Republic of China (MOST grant no. 2006FY110500).

REFERENCES

- BRUNETTI, E. 1920. Diptera Brachycera Vol. 1. *The Fauna of British India, including Ceylon & Burma*. London, 401 pp.
- CHVÁLA, M. 1983. The Empidoidea (Diptera) of Fennoscandia and Denmark. II. General Part. The families Hybotidae, Atelestidae and Microphoridae. *Fauna Entomologica Scandinavica* 12: 279 pp. Scandinavian Science Press, Copenhagen.
- FREY, R. 1953. Studien über ostasiatische Dipteren. II. Hybotinae, Ocydromiinae, *Hormopeza* Zett. *Notulae Entomologicae* 33: 57-71.
- MCALPINE, J. F. 1981. Morphology and terminology - adults. (pp. 9-63). In: MCALPINE, J. F., PETERSON, B. V., SHEWELL, G. E., TESKEY, H. J., VOCKEROTH, J. R. & WOOD, D. M. (eds). *Manual of Nearctic Diptera*. Vol. 1. *Research Branch, Agriculture Canada, Monograph* 27: 1-674.
- SAIGUSA, T. 1963. Systematic studies of the genus *Hybos* in Japan I. New species with yellowish legs (Diptera, Empididae). *Sieboldia* 3(1): 97-104.
- SAIGUSA, T. 1965. Studies on the Formosan Empididae collected by Professor T. Shirôzu (Diptera, Brachycera). *Special Bulletin of Lepidoptera Society in Japan* 1: 180-196.
- SMITH, K. G. V. 1965. Diptera from Nepal: Empididae. *Bulletin of the British Museum (Natural History), Entomology* 17(2): 61-112.
- STEYSKAL, G. C. & KNUTSON, L. V. 1981. 47. Empididae (pp. 607-624). In: MCALPINE, J. F., PETERSON, B. V., SHEWELL, G. E., TESKEY, H. J., VOCKEROTH, J. R. & WOOD, D. M. (eds). *Manual of Nearctic Diptera*. Vol. 1. *Research Branch, Agriculture Canada, Monograph* 27: 1-674.
- YANG, C. & YANG, D. 1986. Fourteen new species of dance flies from Fujian and Hainan (Diptera: Empididae). *Wuyi Science Journal* 6: 75-88.
- YANG, D., MERZ, B. & GROOTAERT, P. 2006. New yellow-legged *Hybos* from Nanling, Guangdong, China (Diptera, Empidoidea, Hybotidae). *Revue suisse de Zoologie* 113(4): 797-806.
- YANG, D. & YANG, C. 1992. Diptera: Empididae (pp. 1089-1097). In: CHEN, S. (ed.). *Insects of the Hengduan Mountains Region*, Vol. 2: 867-1547. Science Press, Beijing.
- YANG, D. & YANG, C. 2004. *Fauna Sinica Insecta* Vol. 34. Diptera, Empididae, Hemerodromiinae Hybotinae. Science Press, Beijing, 329 pp.
- YANG, D., YANG, C. & HU, X. 2002. Diptera: Empididae (pp. 733-740). In: HUANG, F. (ed.). *Forestry Insects of Hainan*. Science Press, Beijing, 1064 pp.
- YANG, D., ZHANG, K. Y., YAO, G. & ZHANG, J. H. 2007. *World catalog of Empididae (Insecta: Diptera)*. China Agricultural University Press, Beijing, 599 pp.

More oribatids from Thailand (Acari: Oribatida)

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More oribatids from Thailand (Acari: Oribatida). - Some of the oribatid material collected by members and co-workers of the Muséum d'histoire naturelle, Genève and of the Hungarian Natural History Museum, Budapest in Thailand is studied. 28 species were identified, 10 of them new to science: *Austrophthiracarus pseudotuberculatus*, *Rhacaplacarus (R.) semiaciculatus*, *Aokiella latiseta*, *Fissicepheus thaiensis*, *Gigantoppia magna*, *Pulchroppia sculpturata*, *Subiasella (Lalmoppia) khaolak*, *Vietoppia insitiva*, *Mahunkaia schwendingeri* and *Oribatella zsilavii*. The new genus *Gigantoppia* is established in the family Oppiidae. Some taxonomical and zoogeographical notes on rare and little known species of this region are presented. *Archegotocepheus* Mahunka, 1988 **stat. n.** is removed from the synonymy of *Megalotocepheus* Aoki, 1965 and now considered as a valid subgenus in *Megalotocepheus*.

Keywords: New taxa - new status - taxonomical and zoogeographical notes.

INTRODUCTION

Research results on the Oribatida fauna of Thailand, based on my own collection, were presented by Mahunka (1994, 1995a, 1995b, 2008) and Mahunka & Mahunka-Papp (1994). Many results on that fauna were published by Aoki (1965, 1968), Niedbala (2000) and Niedbala & Corpuz-Raros (1998). All information available in 1989 on Oriental Acari was compiled by L. A. Corpuz-Raros in an unpublished manuscript of 328 pages.

Intensive collecting in Thailand has been undertaken by members and co-workers of the Muséum d'histoire naturelle (MHNG) for many years. I received several mite samples from the rich material deposited in this museum. These samples and other material from Thailand revealed the occurrence of 28 species, of which 10 are new to science. One new genus is here established belonging to the family Oppiidae. It is noteworthy that among the listed species only a few had been mentioned from Thailand before. Furthermore, the known distribution area of those species known from Southeast Asia has somewhat been extended. *Allonothrus pyriformis* (Berlese, 1913), *Megalotocepheus (Archegotocepheus) singularis singularis* Mahunka, 1988, *Megalotocepheus (Archegotocepheus) brevisetus* Mahunka, 1989, *Senectoppia multisulcata* (Berlese, 1913) are reported from Thailand for the first time.

MATERIAL AND METHODS

As in my earlier papers, I follow the system of Marshall *et al.* (1987), based on that of Grandjean (1954, 1965), with some modifications introduced by Woas (2002), Subías (2004) and Weigmann (2006) and myself (Mahunka 2008). In the descriptions the morphological terminology of Grandjean (in several publications) is used with some modifications concerning the studied groups or organs (e.g., Norton *et al.*, 1997; Mahunka & Mahunka-Papp 2001; Niedbała, 1992, 2000, 2006 and the before mentioned publications).

All material examined is deposited in the Muséum d'histoire naturelle de Genève (MHNG) and in the Hungarian Natural History Museum, Budapest (HNHM).

LIST OF COLLECTING SITES

- As-T-3 (MHNG): Phang Nga Prov., Khao Lak National Park, Tone Chong Fa Waterfall, 100-300 m, Winkler extraction in moist primary forest with secondary spots, 6.-15. I. 1998, leg. A. Schulz & K. Vock.
- TH-07/05 (MHNG): Krabi Prov., Ao Luk Distr., mountain ca 1 km E of Ao Luk Tai, 80 m (semi-evergreen rainforest on limestone), 9./10.VII. 2007, leg. P. Schwendinger.
- TH-04/17 (MHNG): Phang Nga Prov. & city, near Tapan Cave, 20 m (soil at base of limestone cliff), 9. IX. 2004, leg. P. Schwendinger.
- TH-26 (MHNG): Phetchaburi Prov., Kaeng Krachan National Park, 450 m, 19. XI. 1985, leg. D. Burckhardt & I. Löbl.
- As-709 (HNHM): Phetchaburi Prov., Kaeng Krachan National Park, Berlese sample from wet litter and soil near the water basin, with a lot of decaying debris, 9. II. 1994, leg. S. Mahunka & L. Mahunka-Papp.
- As-832 (HNHM): Trang Prov., Khao Chong Botanical Garden, near the staff center, moss, 02. XII. 2003, leg. A. Orosz & G. Sziráki.

LIST OF STUDIED SPECIES

- HYPOCHTHONIIDAE Berlese, 1910
Eohypochthonius crassisetiger Aoki, 1959
 Locality: As-709.
- STEGANACARIDAE Niedbała, 1986
Austrophthiracarus pseudotuberculatus sp. n.
Rhacaplacarus (*R.*) *semiaciculatus* sp. n.
- ORIBOTRITIIDAE Grandjean, 1954
Indotritia propinqua Niedbała, 1991
 Locality: As-709.
Oribotritia bulbifer (Mahunka, 1987)
 Locality: TH-07/05.
- THRYPOCHTHONIIDAE Willmann, 1931
Archeogozetes longisetosus Aoki, 1965
 Localities: AS-T-3, TH-04/17.
- LOHMANNIIDAE Berlese, 1916
Annectacarus krachan Mahunka, 1995
 Locality: As-709.

Meristacarus longisetosus Mahunka, 1978

Locality: As-709.

Meristacarus tuloyus Corpuz-Raros, 1979

Locality: As-T-3.

Paulianacarus rugulosus (Mahunka, 1995)

Locality: As-709.

TRHYPOCHTHONIIDAE Willmann, 1931

Allonothrus pyriformis (Berlese, 1913)

Locality: As-709.

HETEROBELBIDAE Balogh, 1961

Heterobelba galerulata Berlese, 1913

Locality: TH-04/17.

CARABODIDAE C. L. Koch, 1837

Aokiella latiseta sp. n.

TETRACONDYLIDAE Aoki, 1961

Fissicepheus thaiensis sp. n.

OTOCEPHEIDAE Balogh, 1961

Megalotocepheus (Archegotocepheus) brevisetus Mahunka, 1989

Locality: As-T-3.

Megalotocepheus (Archegotocepheus) singularis singularis Mahunka, 1988

Locality: As-T-3.

Otocepheus (Acrotocepheus) excelsus Aoki, 1965

Locality: As-T-3.

Otocepheus (Otocepheus) heterosetiger Aoki, 1965.

Locality: As-T-3.

OPPIIDAE Sellnick, 1937

Gigantoppia magna gen. n., sp. n.

Pulchroppia sculpturata sp. n.

Senectoppia multisulcata (Berlese, 1913)

Localities: TH-26, As-709.

Subiasella (Lalmoppia) khaolak sp. n.

Vietoppia insitiva sp. n.

EREMAEOZETIDAE Piffel, 1972

Mahunkaia schwendingeri sp. n.

AUSTRACHTERIIDAE LUXTON, 1985

Allozetes pusillus (Berlese, 1913)

Locality: TH-04/17.

Lamellobates molecula (Berlese, 1916)

Locality: As-709.

ORIBATELLIDAE Jacot, 1925

Oribatella zsilavii sp. n.

GALUMNIDAE Jacot, 1925

Bigalumnella csavatorum Mahunka, 1994

Localities: TH-26, As-709.

NOTES ON THE SPECIES STUDIED AND DESCRIPTIONS OF NEW TAXA

Eohypochthonius crassisetiger Aoki, 1959

Figs 1-2

REMARKS: Although Aoki's (1977) description corresponds well with the morphological characters of the specimens examined, attention should be drawn to some deviations. The specimens at hand are smaller (288-305 μm), the rostral setae are somewhat longer, the interlamellar setae are blunt and rather spoon-shaped, the sensillus is strongly widened in the middle. On the other hand, the following morphological features are identical: The shape of the postlateral protuberance of the prodorsum, the broad and densely aciculated interlamellar setae, the shape and length of the notogastral setae (Fig. 1). In comparing the drawing (Fig. 2) of Corpuz-Raros & Garcia (2003) with that of Aoki other differences are visible, as e.g. the shape of the notogastral and interlamellar setae. So, the material from the Philippines may not be conspecific.

Austrophthiracarus pseudotuberculatus sp. n.

Figs 3-9

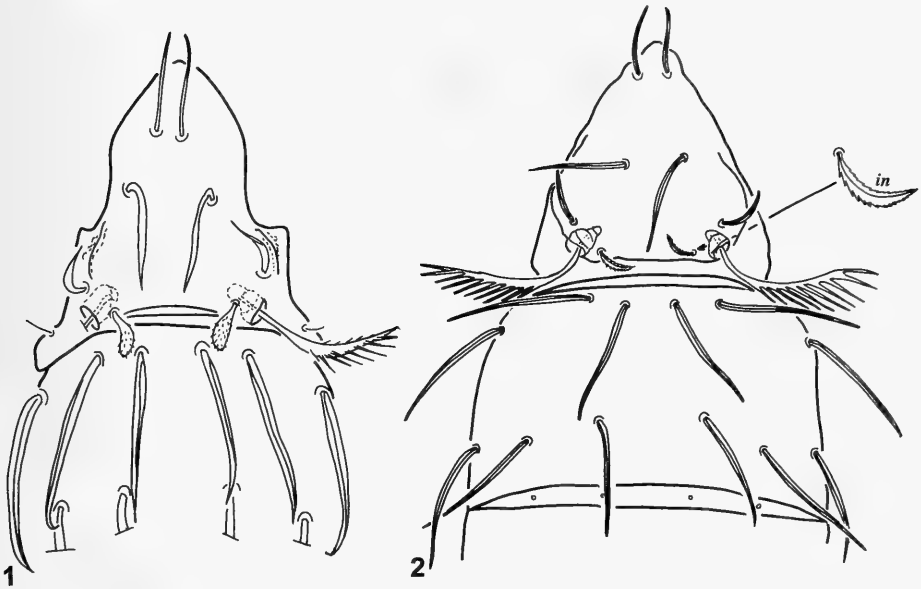
MATERIAL EXAMINED: Holotype: Phang Nga Prov., Khao Lak National Park, Tone Chong Fa Waterfall, 100-300 m, Winkler extraction in moist primary moist forest with secondary spots, 6.-15. I. 1998, leg. A. Schulz & K. Vock (As-T-3), deposited in MHNG.

DIAGNOSIS: Entire body surface ornamented with deep alveoli. Prodorsal outline undulating, with two hollows in lateral view. A pair of median cristae present. Lateral carina short, lateral rim weakly developed. Rostral setae short and smooth, interlamellar setae strong, erect, aciculate, lamellar setae minute. Sensillus long, curved, directed outwards, its head well aciculate. Fifteen pairs of notogastral setae also strong and aciculate, two pairs of vestigial notogastral setae and two pairs of lyrifissures present. Two shorter pairs of anal and one very long pair of adanal setae (ad_1) located along the inner margin of the ano-adanal plates. One pair of setae (ad_2) laterally to them, ad_3 similar to the anal setae. Genital setae arranged in two longitudinal rows.

MEASUREMENTS: Length of aspis 416 μm , length of notogaster 886 μm , height of notogaster 512 μm .

DESCRIPTION: *Aspis*: Surface mostly with rough sculpture, formed by deep alveoli. A pair of long, parallel median cristae present, connected anteriorly, nearly M-shaped (Fig. 8). Their small apices bearing smooth, thin but spinose rostral setae. Lateral carina short, lateral rim similar in length, its anterior part absent, and both lines reaching the sinus-line (Fig. 9). Median posterior apodema well observable. Lamellar setae minute, very thin, interlamellar setae bacilliform, finely aciculate. Sensillus directed upwards and outwards, curved, long, its head well dilated, distal end aciculate (Fig. 4). Exobothridial setae minute.

Notogaster: Surface ornamented by strong, deep, cup-shaped alveoli (Fig. 3), in their inner part a point observable. Fifteen pairs of long, mostly anteriorly curved, spiniform and aciculate notogastral setae present, the vestigial f_1 seta situated behind h_1 , close to it. Setae c_3 situated at the collar line, all other setae c located far from the collar line (Fig. 3). Lyrifissures hardly visible, only *ia* and *im* observable.



FIGS 1-2

Eohypochthonius crassisetiger Aoki, 1959. (1) Specimen from Thailand. (2) Specimen from the Philippines (after Corpuz-Raros & Garcia, 2003).

Ventral parts: A well-developed keel present on the ano-adanal plates (Fig. 7), reaching insertion of posterior adanal setae (ad_1). Three pairs of ano-adanal setae situated on inner margin of ano-adanal plates, anal setae equal in length. Two pairs of adanal setae nearly twice longer than anal setae, the fifth setae (ad_3) nearly as long as the anal setae (Figs 5,7). All setae finely roughened. Nine pairs of genital setae present, originating in two longitudinal rows; setae $g_1 - g_4$ much longer and more strongly curved than the others, located further from the inner margin. All genital setae straight.

Legs: All legs monodactylous. Setae d on femur I thick and curved (Fig. 6), setae v'' very long, more than five times longer than setae v' .

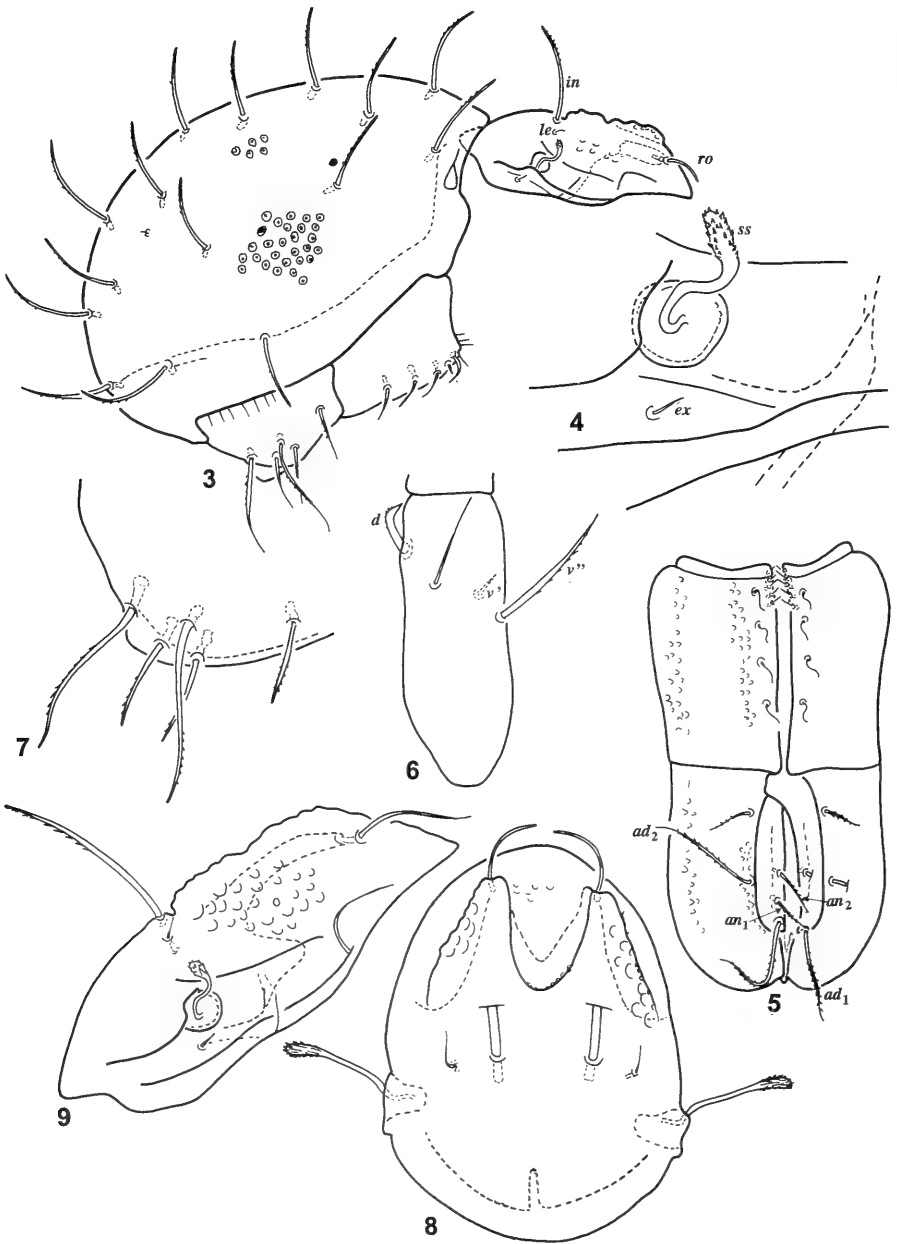
REMARKS: The new species is very similar to *Austrophthircarus tuberculatus* (Niedbala & Corpuz-Raros, 1998). Both species differ primarily by the form of the long and well protruding median crista on the ano-adanal plates, by the form of the prodorsal cristae (much longer in *tuberculatus*) and by the length and the insertions of the rostral setae (much longer and arising between the cristae in *tuberculatus*).

ETYMOLOGY: The species name refers to similarities with the related species.

***Rhacaplacarus (R.) semiaciculatus* sp. n.**

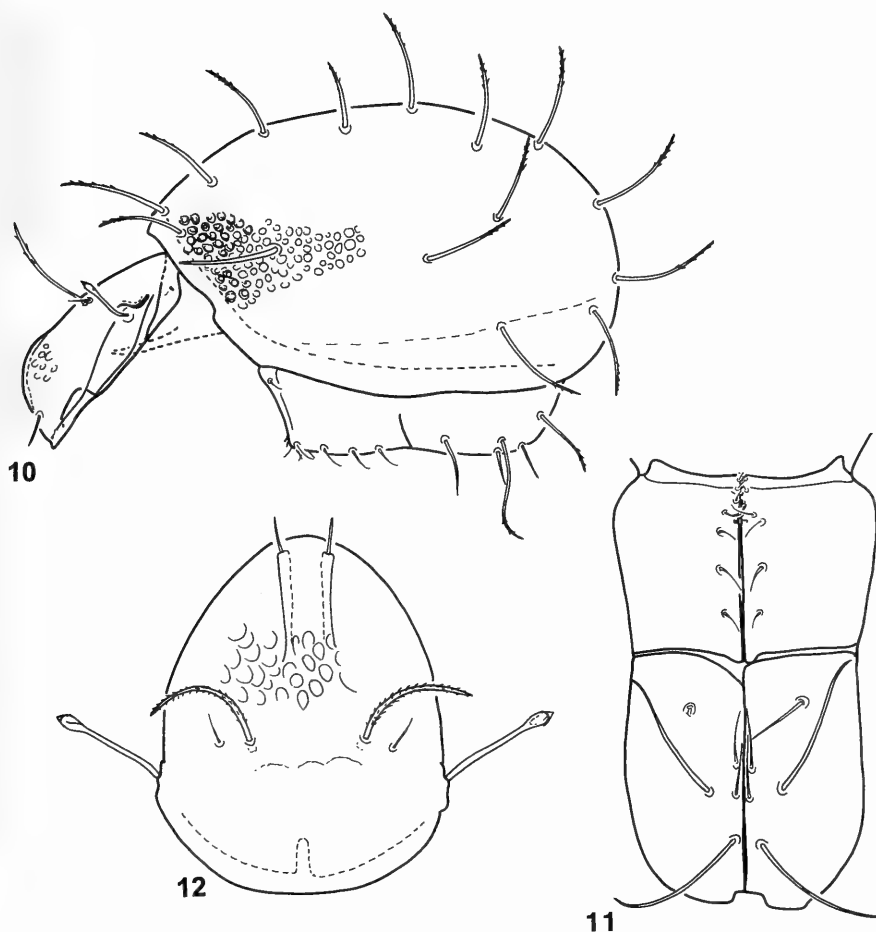
Figs 10-12

MATERIAL EXAMINED: Holotype: Phang Nga Prov., Khao Lak National Park, Tone Chong Fa Waterfall, 100-300 m, Winkler extraction in primary moist forest with secondary spots, 6.-15. I. 1998, leg. A. Schulz & K. Vock (As-T-3). 1 paratype from the same sample. Holotype deposited in MHNG, paratype (1758-PO-2008) in HNHM.



FIGS 3-9

Austrophthiracarus pseudotuberculatus sp. n. (3) Body in lateral view. (4) Trichobothrium. (5) Genitoanal region. (6) Femur I. (7) Anal setae. (8) Aspis in dorsal view. (9) Aspis in lateral view.



FIGS 10-12

Rhacaplaccarus (R.) semiaciculatus sp. n. (10) Body in lateral view. (11) Genitoanal region. (12) Aspis in dorsal view.

DIAGNOSIS: Body surface ornamented by large alveoli. Median crista present, lateral carina long, reaching over the sinus-line. Lateral rim short. Rostral and lamellar setae short, spiniform and smooth; interlamellar setae strong, erect, scarcely aciculate; exobothridial setae represent only by alveoli. Sensillus long, directed outwards, its head rounded. Fifteen pairs of strong and distally slightly aciculate notogastral setae present. Two pairs of anal setae arising along the inner margin of the ano-adanal plates. One pair of setae (ad_2) laterally to them, ad_3 longer than the anal ones. Genital setae arranged in two longitudinal rows.

MEASUREMENTS: Length of aspis 346-412 μm , length of notogaster 762-872 μm , height of notogaster 541-638 μm .

DESCRIPTION: *Aspis*: Surface mostly with rough sculpture formed by deep alveoli medially. Lateral and basal parts nearly smooth. A long, only slightly protruding median crista present, its anterior part bearing rostral setae. Lateral carina long, reaching over the sinus-line and much longer than the lateral rim. Posterior median apodema well observable. Rostral and lamellar setae very short, straight, narrow-spiniform. Interlamellar setae very long, curved laterally, spiniform, very finely aciculate. Aciculi located only at their distal end. Sensillus directed upwards and outwards, straight in dorsal view (Fig. 12); its head well dilated, distal end slightly aciculate. Exobothridial setae represented only by their minute alveoli.

Notogaster: Surface ornamented with strong, deep, rounded, well-marked alveoli (Fig. 10); their diameter much longer than the distance between the alveoli. Fifteen pairs of long, mostly anteriorly curved, spiniform and distally finely aciculate notogastral setae present; the alveoli of the vestigial f_1 and f_2 setae not observable. Setae c_1 and c_3 arising at the collar line, position of other setae as shown in Fig. 10. Lyrifissures not visible.

Ventral parts: Three pairs of ano-adanal setae situated on inner margin of ano-adanal plates; anal setae equal in length; setae ad_1 shorter than ad_2 . Fifth setae (ad_3) clearly longer than anal ones (Fig. 11). All setae finely aciculate. Nine pairs of genital setae present, originating in two longitudinal rows; setae $g_1 - g_4$ much longer and distinctly curved, more strongly so than others, located further away from inner margin. All genital setae curved.

Legs: All legs monodactylous. Setae d on femur I thick and curved, setae v'' very long, more than three times longer than setae v' . Setae d of tibia IV long and independent of solenidia, both very long, filiform.

REMARKS: The new species is closely related to *Rhacaplacarus indicus* Bayoumi & Mahunka, 1979 [= *Plonaphracarus indicus* (Bayoumi & Mahunka, 1979) according to Subias 2004] and belongs to the *kugohi* species group. The rostral setae of the new species are smooth, short (much longer and aciculate in *indicus*), its exobothridial setae are represented only by alveoli (present as setae in *indicus*) and its alveoli are much larger and stronger than in related species.

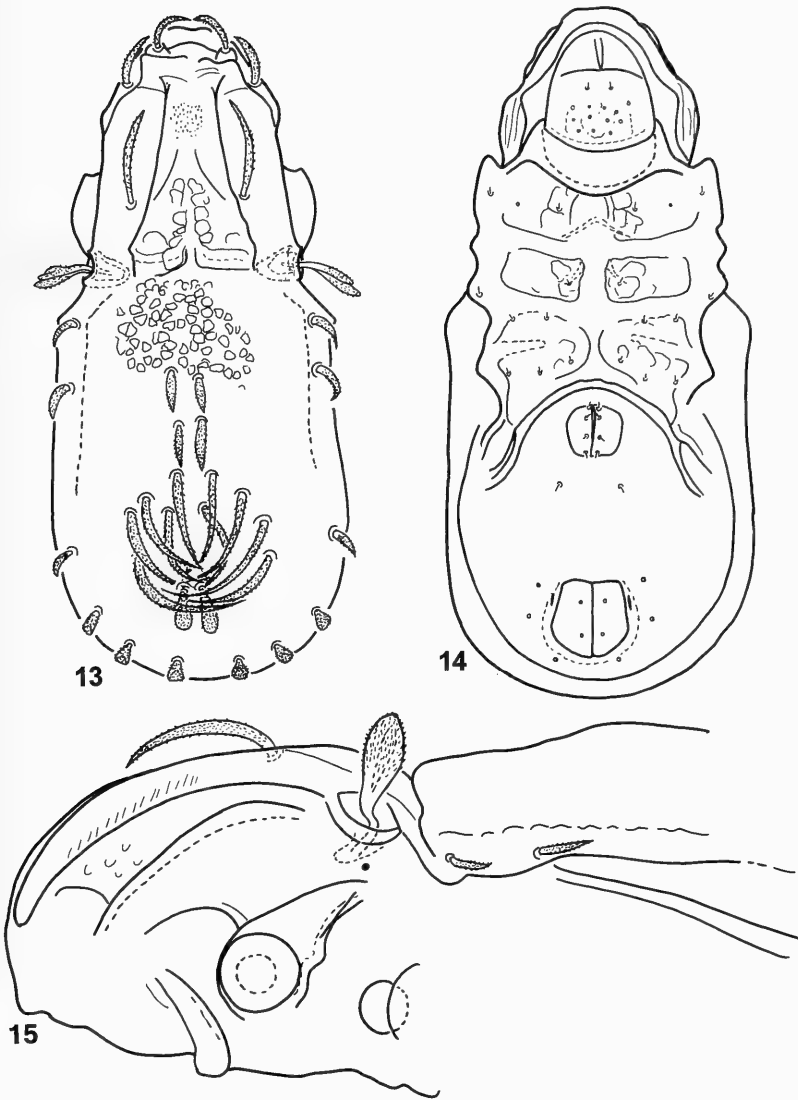
ETYMOLOGY: The species name refers to the characteristically aciculate prodorsal and notogastral setae.

***Aokiella latiseta* sp. n.**

Figs 13-15

MATERIAL EXAMINED: Holotype: Phang Nga Prov. & city, near Tapan Cave, 20 m (soil at base of limestone cliff), 9. IX. 2004, leg. P. Schwendinger (TH-04/17). 1 paratype from the same sample. Holotype deposited in MHNG, paratype (1759-PO-2008) in HNHM.

DIAGNOSIS: Whole body surface covered with thin, partly broken cerotegument. Rostral setae slightly lamellar and interlamellar ones distinctly dilated. Interlamellar setae arising from lamellar surface. Interlamellar region punctulate anteriorly, with five pairs of large maculae. Sensillus spoon-shaped, with two distinctly barbed marginal crests. Notogaster with 14 pairs of dilated, nearly phylliform notogastral setae, six pairs of them forming a posteromedian knot. All setae in the ventral region minute, hardly discernible. Genito-anal setal formula: 4 - 1 - 2 - 3. All legs monodactylous.



FIGS 13-15

Aokiella latisetia sp. n. (13) Body in dorsal view. (14) Body in ventral view. (15) Anterior part of podosoma in lateral view.

MEASUREMENTS: Length of body 373-396 μm , width of body 159-170 μm .

DESCRIPTION: *Prodorsum*: Rostrum widely rounded, without apex. Lamellae situated laterally, well-developed, their surface smooth, lateral margin grooved. Interlamellar region punctate anteriorly, with some crests, directed anteriorly and carrying five pairs of large alveoli in posteromedian part (Fig. 13). Rostral setae spindle-shaped,

short; lamellar setae comparatively thin, thinner than other dorsal setae; interlamellar setae long, similar in shape. Sensillus spoon-shaped, large, directed outwards. Two marginal veins well observable.

Notogaster: Whole surface covered by small angular tubercles forming polygonal groups. Fourteen pairs of notogastral setae present. No setae in sejugal region medially, two pairs in humeral, four pairs in posteromarginal region, two anteromedian pairs located one behind the other in a longitudinal position medially. Remaining setae (six pairs) forming a posteromedian group located also medially, standing in opposite directions, crossing each other (Fig. 13). All notogastral setae dilated, mostly spindle- or ribbon-shaped, roughened, setae in the posteromedian groups much longer than others.

Lateral part of podosoma: Tutorium weakly developed, without apex (Fig. 15). Pedotectum 1 large, completely covering the acetabulum of leg I.

Ventral parts (Fig. 14): Surface of infracapitulum rarely foveolate, setae *h* minute. Apodemes and epimeral borders well-developed, except *bo*. 3, forming a closed network. Posterior borders of epimeral region conspicuously strong, well-sclerotised. Epimeres with large polygonal fields mostly along sternal borders. Epimeral setal formula: 3 - 1 - 3 - 3. All setae minute, or represented only by their alveoli. Surface of ventral, genital and anal plates smooth. All their setae also very small, or only their alveoli visible. Genitoanal setal formula: 4 - 1 - 2 - 3, all setae hardly observable. Adanal setae located very near to anal apertures, lyrifissures *iad* also in adanal position.

REMARKS: The genus *Aokiella* Balogh & Mahunka, 1967 is considered by Subias to be a subgenus of *Odontocephus* Berlese, 1913. I do not agree with him, although, no doubt, some kind of relationship exists between the two taxa. The structure of the dorsosejugal region of *Aokiella* is different, the notogastral setae are arranged in a posteromedial group, and the shape of the tutorium clearly separates the species of *Aokiella* from others. Only the type species (*A. florens* Balogh & Mahunka, 1967), *A. latisetata* sp. n. and one other species (*A. rotunda* Hammer, 1979) belong to this lineage. The new species may readily be differentiated from both close relatives by the position and the form of its setae.

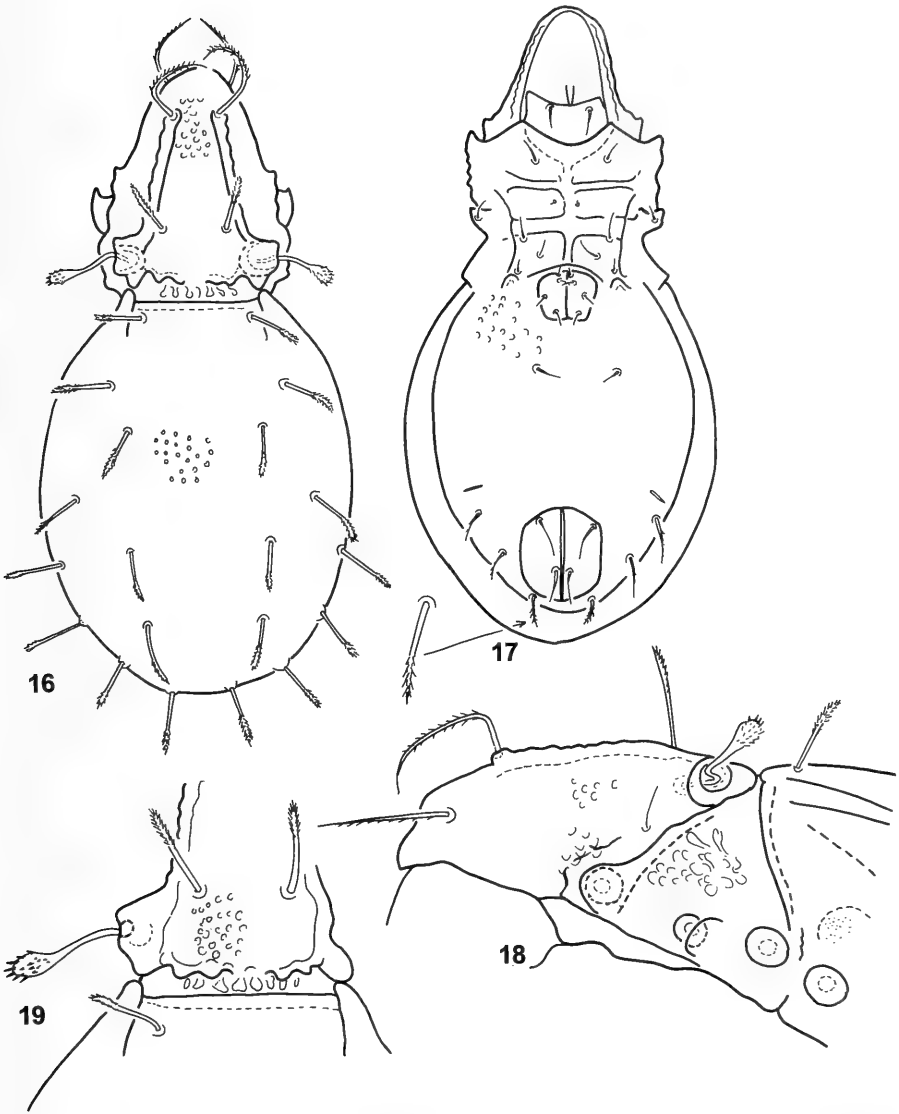
ETYMOLOGY: The species name refers to the wide dorsal setae.

Fissicepheus thaiensis sp. n.

Figs 16-19

MATERIAL EXAMINED: Holotype: Phetchaburi Prov., Kaeng Krachan National Park, Berlese sample from wet litter and soil near the water basin, with a lot of decaying debris, 9. II. 1994, leg. S. Mahunka & L. Mahunka-Papp (As-709). 1 paratype from the same sample. 1 paratype: Phetchaburi Prov., Kaeng Krachan National Park, 450 m, 19. XI. 1985, leg. D. Burckhardt & I. Löbl (TH-26). Holotype (1760-HO-2008) deposited in HNHM, 2 paratypes in MHNG.

DIAGNOSIS: Lamellae narrow, lamellar setae situated on their apices. Prodorsal condyles laterally present as a pair of waved laths. Behind them three pairs of small, weak tubercles. Peduncle of sensillus long, its head short, with spines. Notogaster with one pair of lateral tubercles, anterior border of notogaster straight medially. Ten pairs of equally long notogastral setae, all pilose in their distal third. Epimeral setal formula: 2 - 0 - 2 - 3. Four pairs of genital setae, aggenital condyles weak.



FIGS 16-19

Fissicepheus thaiensis sp. n. (16) Body in dorsal view. (17) Body in ventral view. (18) Anterior part of podosoma in lateral view. (19) Dorsosejugal region.

MEASUREMENTS: Length of body 560-573 μm , width of body 276-284 μm .

DESCRIPTION: *Prodorsum*: Surface distinctly foveolate. Lamellae converging anteriorly (Fig. 16), their surface also ornamented with foveolae. Bothridium with basal tubercle. Behind the condyles some irregular and weakly developed tubercle (Fig. 19) also present. Rostral setae setiform, lamellar setae characteristically curved

inwards (Fig. 16) and peculiarly ciliate. Interlamellar setae bacilliform, with distinctly barbed distal third. Sensillus long, with small, rounded barbed head.

Notogaster: One pair of notogastral condyles located in humeral position. Median sejugal lines straight, without structure. Surface of notogaster similar to that of prodorsum, ten pairs of setae bacilliform (like interlamellar setae) and barbed (Fig. 16). All of same length and form.

Lateral part of podosoma: Exobothridial setae thin, pedotecta I long, round. Pedotecta 2-3 small, typical for the genus (Fig. 18).

Ventral parts (Fig. 17): Apodemes well-developed, a transversal lath also present in front of the genital aperture. Genital condyles weak, opposite them a longer, thin line with triangular end in epimeral region. Epimeral setae simple, thin, setiform, setae *1a*, *2a* and *3a* reduced and/or absent. Surface of ventral plate foveolate. Four pairs of genital setae simple, short; aggenital ones longer; anal setae longest of all on ventral plate. Adanal setae more strongly ciliate than others in this region, like the dorsal setae. Posterior anal setae arising much closer to each other than the anterior ones. Lyrifissures *iad* located laterally, far from anal apertures, in front of setae *ad*₃.

REMARKS: On the basis of the form and length of the sensillus and the form of the notogastral setae, the species of the genus *Fissicepheus* Balogh & Mahunka, 1965 can be divided into three groups. The new species belongs to the second group, which is characterised by a long sensillus and distally well pilose notogastral setae. The new species is well distinguished from all congeners by the form of the condyles and of the basal tubercles of the prodorsum, as well as by the bacilliform notogastral setae.

ETYMOLOGY: Named after its country of origin.

Subgenus *Archegotocepheus* Mahunka, 1988 **stat. n.**

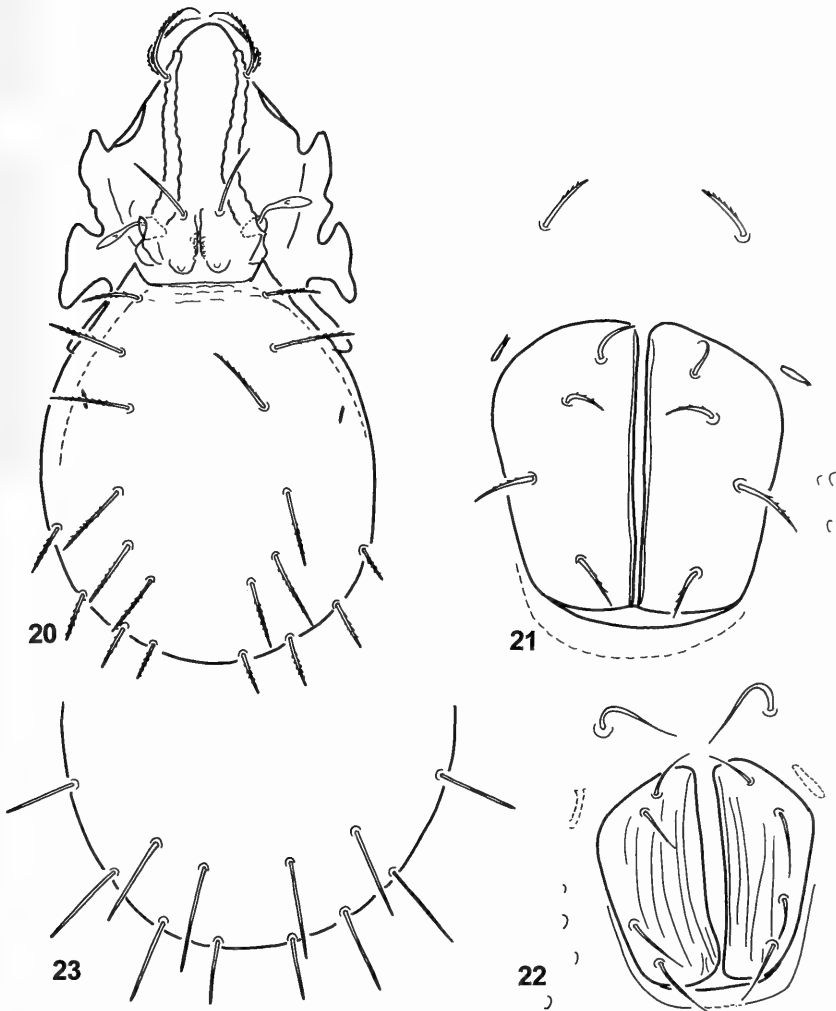
REMARKS: Mahunka (1988) described *Archegotocepheus* as a genus (with two new species in it) from Sabah (East Malaysia) on the basis of its anal neutrichy. Later Subias (2004), in his new system, synonymized *Archegotocepheus* with *Megalotocepheus* Aoki, 1965, arguing about the generic value of this feature. When describing *M. latus*, Aoki (1965) did not establish a separate genus for that single species, because it then was the only one known with this feature. My opinion is that the presence of the anal neutrichy in three species is synapomorphic and clearly distinguishes them from all other species. In other words, the establishment of a taxon in the genus group is more than justified. Since other subgenera already exist in the the family Otocephidae, *Archegotocepheus* is here removed from synonymy and retained as a subgenus of *Megalotocepheus*. Therefore I propose the following combinations:

Megalotocepheus (*Archegotocepheus*) *brevisetus* (Mahunka, 1989) (Figs 20-21)

Megalotocepheus (*Archegotocepheus*) *latus* Aoki, 1965

Megalotocepheus (*Archegotocepheus*) *singularis singularis* (Mahunka, 1988) (Figs 22-23)

It is interesting to note that *brevisetus*, *singularis* and *latus* were all discovered in Thailand, and what is even more interesting, that the first two species were collected from the same sample.



FIGS 20-23

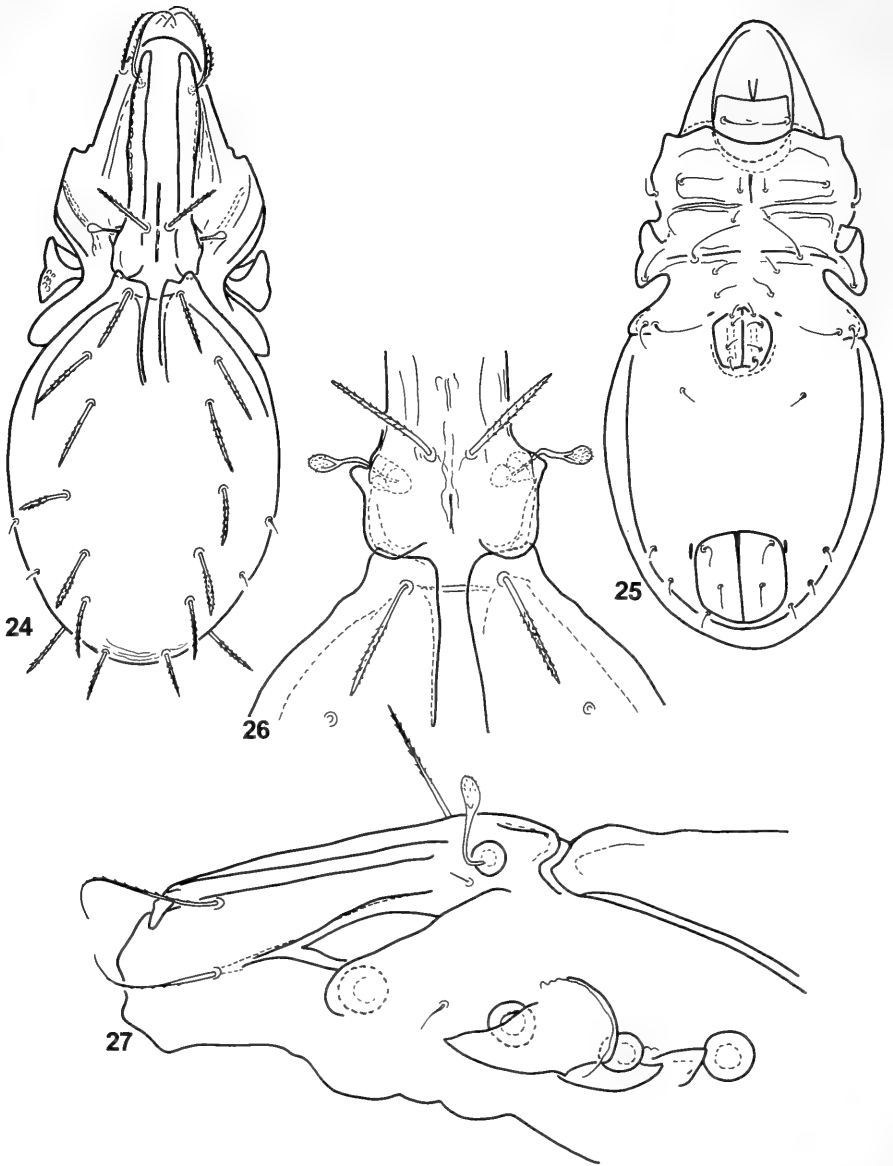
Megalotocepheus (A.) *brevisetus* Mahunka, 1989. (20) Body in dorsal view. (21) Genital plates. *Megalotocepheus* (A.) *singularis singularis* Mahunka, 1988. (22) Genital plates. (23) Posterior end of notogaster.

***Otocepheus* (*Otocepheus*) *heterosetiger* Aoki, 1965**

Figs 24-27

REMARKS: Detailed examination of the available specimens revealed the species as variable, especially concerning the notogastral setae. Part of the notogastral setae (lp , h_1 and h_2) are slightly dilated and curved. Figures are given for the recently collected specimens (Figs 24-27).

MEASUREMENTS: Length of body 1038-1302 μm , width of body 430-582 μm .



FIGS 24-27

Otocephus (O.) heterosetiger Aoki, 1965. (24) Body in dorsal view. (25) Body in ventral view. (26) Dorsosejugal region. (27) Anterior part of podosoma in lateral view.

Gigantoppia gen. n.

DIAGNOSIS: Very large, robust species, its notogaster very high, semicircular. Prodorsum with long, well-developed costulae bearing lamellar setae. Sensillus setiform, some tubercles in the interbothridial region. Exobothridial region granular. Nine

pairs of medium-long notogastral setae. Apodemes well-developed, posterior border with postepimeral fossa. Genitoanal setal formula: 5 - 1 - 2 - 3. Lyrifissures *iad* in adanal, setae ad_3 in preanal position.

TYPE SPECIES: *Gigantoppia magna* sp. n.

REMARKS: In some peculiar features (e.g., thick and long costulae, long setiform sensillus, postepimeral fossa) *G. magna* sp. n. greatly differs from all other known oppiid species. As the relationships of the new genus and species are unclear, I provisionally place it in the subfamily Granloppiinae Balogh, 1983. Further studies are necessary.

Gigantoppia magna sp. n.

Figs 28-30

MATERIAL EXAMINED: Holotype: Phang Nga Prov., Khao Lak National Park, Tone Chong Fa Waterfall, 100-300 m, Winkler extraction in moist primary forest with secondary spots, 6.-15. I. 1998, leg. A. Schulz & K. Vock (As-T-3). 3 paratypes in the same sample. 1 paratype: Phang Nga Prov. & city, near Tapan Cave, 20 m (soil at base of limestone cliff), 9. IX. 2004, leg. P. Schwendinger. Holotype and 2 paratypes deposited in MHNG, 2 paratypes (1761-PO-2008) in HNHM.

DIAGNOSIS: Rostral apex blunt, wide. Prodorsum with well-developed, curved costulae, its surface distinctly granular laterally. Sensillus long, setiform, slightly dilated medially. Notogaster hemispherical, high. Ten pairs of notogastral setae, setae c_2 vestigial. Epimeral region strongly sclerotised, a row of angular fields present in front of the sejugal apodemes. Last epimeral borders with a well-developed fossa. Genito-anal setal formula: 5 - 1 - 2 - 3, setae ad_1 in postanal, ad_3 in preanal, lyrifissures *iad* in para-anal position.

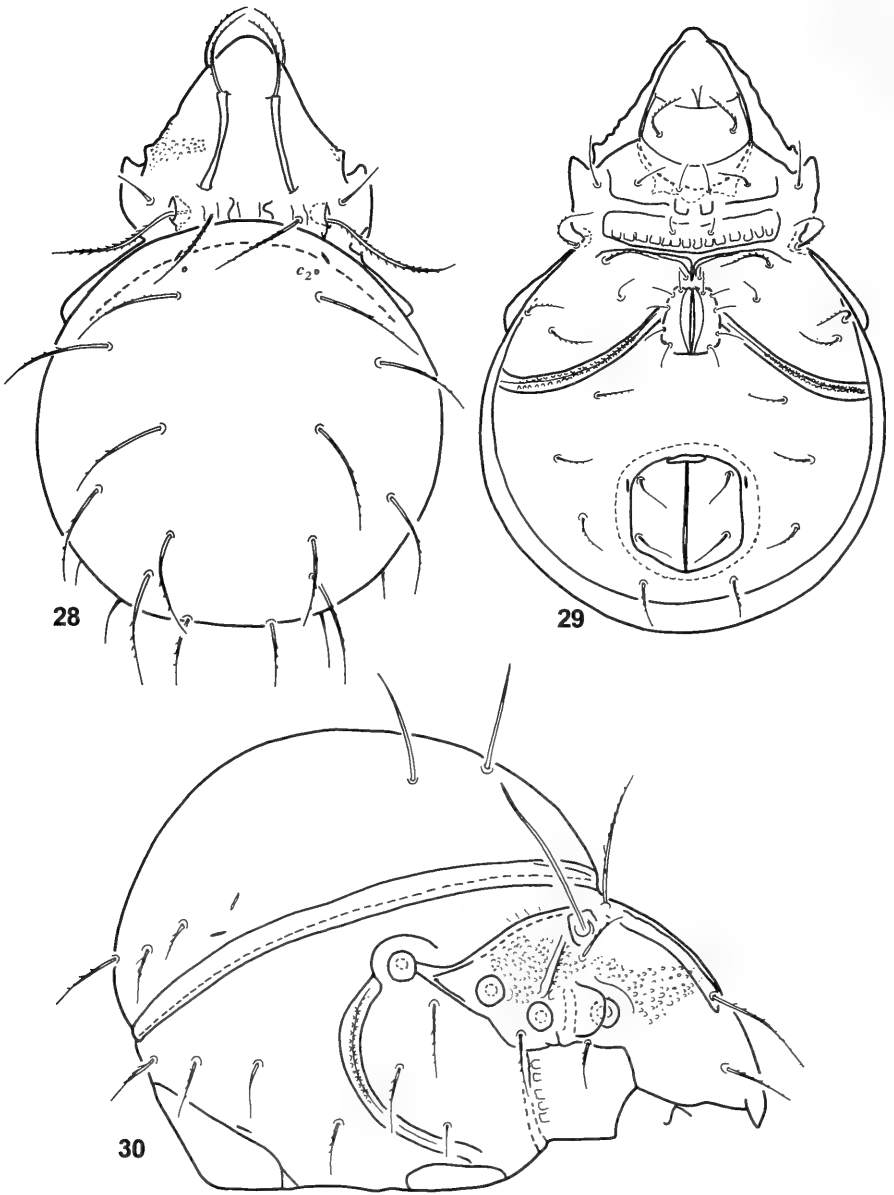
MEASUREMENTS: Length of body 845-997 μm , width of body 581-638 μm .

DESCRIPTION: *Prodorsum*: Rostral apex wide, rounded in dorsal, beak-shaped in lateral view. Prodorsal surface with well-developed, diverging costulae (Fig. 28) reaching bothridia, their distal end bearing lamellar setae. A narrow, transversal median field connected to distinctly granular lateral region. Two pairs of irregular projections present basally in the interbothridial region. Bothridium small, cup-shaped, sensillus long, setiform, slightly dilated medially, finely ciliate, similar to other prodorsal setae. Ratio of these setae $ex < ro > le > in$.

Notogaster: Highly rounded (Fig. 30). Setae c_2 represented only by their alveoli, six pairs of notogastral setae of nearly medium length, distinctly pilose. Posteromarginal setae much shorter than preceding ones, setae ps_1 longest, setae ps_3 the shortest among them (Fig. 28).

Lateral part of podosoma: Exobothridial region distinctly granular (Fig. 30), its anterior part larger, posterior part covered by smaller granules. Pedotecta 1 round, pedotecta 2-3 reduced, discidium very long, without sharply pointed distal end.

Ventral parts: Epimeral region strongly sclerotised, anterior epimeres not touching each other medially, without median borders. Sejugal and posterior apodemes well-developed, sejugal borders double, *bo. 4* with fossa, with some granules (Fig. 29). A row of small, angular fields ornamenting this surface parallel to sejugal border. Inner pairs of epimeral setae (*1a*, *2a*, *3a*) thin, smooth, all other pairs thicker and pilose. Genito-anal setal formula: 5 - 1 - 2 - 3, all genital setae fine, thin, arranged in one row



FIGS 28-30

Gigantoppia magna gen. n., sp. n. (28) Body in dorsal view. (29) Body in ventral view. (30) Anterior part of podosoma in lateral view.

near lateral margin of anal plates. Aggenital and adanal setae pilose, thicker than anal ones. Setae ad_1 in postanal, ad_2 in para-anal and ad_3 in preanal position. Lyrifissures *iad* located very near to anal aperture, at the anterior corner.

Legs: Narrow, the segments long.

REMARKS: The placement of the new species is problematic; see remarks to the new genus.

ETYMOLOGY: The specific epithet refers to the extraordinary body size of these mites.

***Pulchroppia sculpturata* sp. n.**

Figs 31-33

MATERIAL EXAMINED: Holotype: Thailand, Trang Prov., Khao Chong Botanical Garden, 02. XII. 2003, leg. A. Orosz & G. Sziráki (As-832). 1 paratype from the same sample. Holotype (1762-HO-2008) deposited in HHNM and paratype in MHNG.

DIAGNOSIS: Rostrum elongate. Costula long, a pair of lateral laths also observable. Two pairs of tubercles basally and four pairs of maculae medially in the interbothridial region. Rostral setae simple, lamellar and interlamellar ones distinctly pilose. Sensillus with seven rami. Posteromarginal surface of notogaster ornamented with flat pustules. Ten pairs of notogastral setae present, setae c_2 minute, all others long. Sejugal apodemes with one pair of large tubercles. Epimeral and ventral surface with strong polygonate sculpture. Lyrifissures *iad* in para-anal position.

MEASUREMENTS: Length of body 427-452 μm , width of body 188-201 μm .

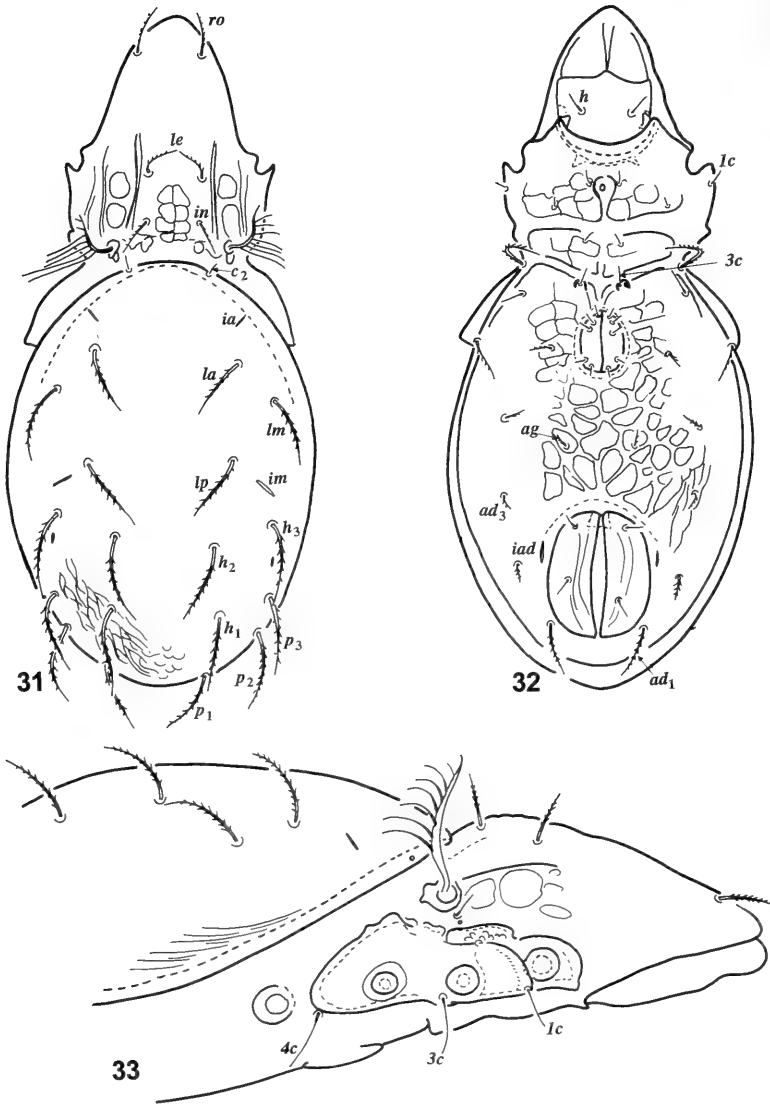
DESCRIPTION: *Prodorsum*: Rostrum elongate, its median part rounded anteriorly. Rostral setae located laterally, very far from each other. Lamellar lines distinct, a pair of lateral laths also clearly visible. Along the lateral laths two pairs of larger and some smaller alveoli present (Fig. 31). Lamellar setae situated between the lamellar lines, far from distal end of prodorsum. Rostral setae hardly, lamellar and interlamellar setae distinctly pilose. Basal part of interlamellar region with four pairs of maculae, basal margin of this field with a pair of larger and a pair of smaller tubercles. Bothridium with a large posteromarginal tubercle. Sensillus pectinate, its seven branches curved, varying in length.

Notogaster: Dorsosejugal suture convex, crista absent. Its posteromarginal surface ornamented with flat, irregularly arranged pustules, framed by rugae (Fig. 31). Some irregular rugae present also along median margin. Ten pairs of notogastral setae present, setae c_2 minute, short, all others much longer, bearing long and distinct cilia.

Lateral part of podosoma: Exobothridial setae short. A distinct border with some tubercles running along the acetabula dorsally (Fig. 33). Pedotecta 1 small, round. Discidium large, with distinct dorsal margin.

Ventral parts (Fig. 32): Apodemes of epimere 1 well-developed, sternal one ending in a round anterior thickening. Sejugal apodemes also distinct, bearing one pair of round tubercles on their posterior margin. A short part of the sternal apodemes also directed to the genital opening. Epimeral surface ornamented with polygonal pattern, a similar one observable on ventral surface medially. Epimeral setae mostly short, setae $3c$ and $4c$ conspicuously long, distinctly ciliate. Surface of genital plates smooth, anal plates with longitudinal ribs. Adanal setae different in length, ad_1 the longest, ad_3 the shortest. Lyrifissures *iad* in para-anal position, located near to the anal opening.

REMARKS: On the basis of the long notogastral setae, as well as the interlamellar pattern, the new species is closest to *Pulchroppia granulata* Mahunka, 1988 and *P. ele-*



FIGS 31-33

Pulchroppia sculpturata sp. n. (31) Body in dorsal view. (32) Body in ventral view. (33) Anterior part of podosoma in lateral view.

gans Hammer, 1980. The notogastral setae of *P. elegans* are smooth (conspicuously ciliate in the new species), interlamellar setae of *P. granulate* are long (short in the new species). The new species is distinguishable from these two species also by the pattern of the ventral plate. It is medially completely covered by a polygonal pattern which is partly absent in the two congeners. The new species is distinguished from *P. mala-*

pectinata (Corpuz-Raros, 1979) by the presence of c_2 setae (absent in *malapectinata*) and by the form of the sensillus.

ETYMOLOGY: The species name refers to the sculpture of the prodorsum and the notogaster.

Subiasella (Lalmoppia) khaolak sp. n.

Figs 34-36

MATERIAL EXAMINED: Holotype: Thailand, Phang Nga Prov., Khao Lak National Park, Tone Chong Fa Waterfall, 100-300 m, Winkler extraction in primary moist forest with secondary spots, 6.-15. I. 1998, leg. A. Schulz & K. Vock (As-T-3). 9 paratypes from the same sample. Holotype and 6 paratypes deposited in MHNG and 3 paratypes (1763-PO-2008) in HNHM.

DIAGNOSIS: Prodorsum with weak lamellar and distinct lateral lines. Two pairs of large maculae in interbothridial region. Bothridium with wide posteromarginal tubercles, sensillus distinctly dilated, fusiform, distal margin with 8-9 cilia in one row on its distal margin. Notogastral setae short, curved. Apodemes and epimeral borders (except *bo. 4.*) well-developed, *bo. 3.* and *bo. 4.* absent. Sejugal borders with a pair of large tubercles. Setae short, simple, situated in genito-anal position, except for setae ad_1 and setae ad_2 . Five pairs of genital setae present.

MEASUREMENTS: Length of body 275-302 μm , width of body 132-143 μm .

DESCRIPTION: *Prodorsum*: Rostral part of prodorsum widely rounded, without distinct apex. Rostral setae situated laterally, far from each other. A pair of short costulae present, lamellar setae situated near distal end of the costulae, at their inner margins (Fig. 34). A pair of strongly sclerotised lateral laths also present; two pairs of interbothridial maculae, between them a short, weak crest visible. Bothridium large, with wide posterior tubercles. Sensillus lanceolate, directed mostly backwards, its head wide, with medium-long cilia only on one side.

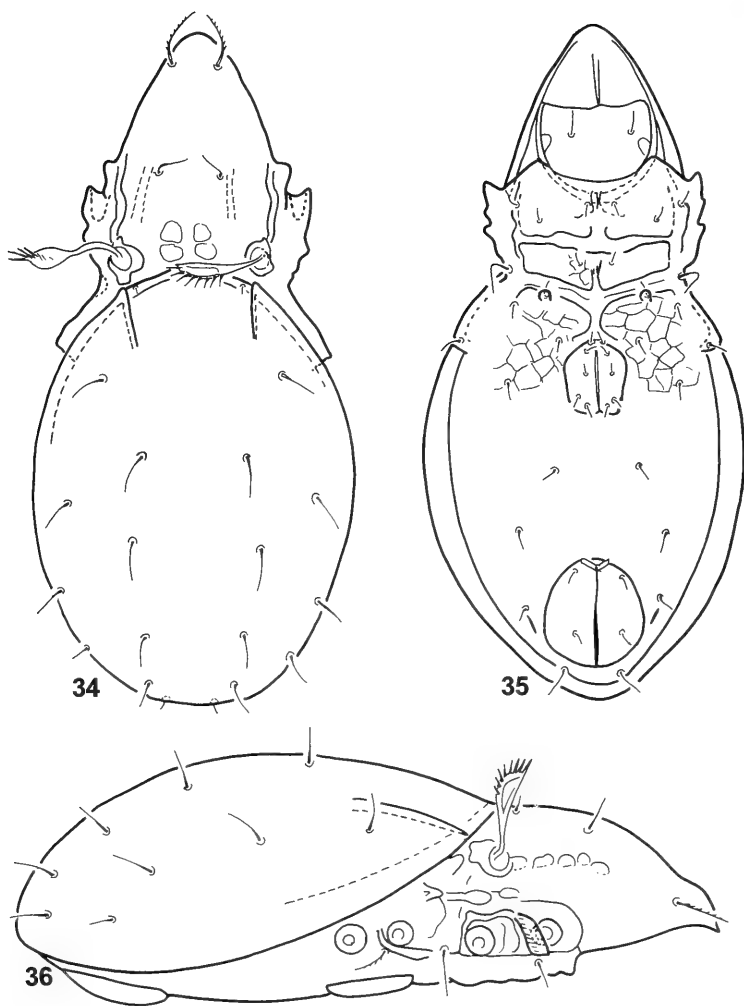
Notogaster: Elongate. A pair of long, well-developed cristae present. Ten pairs of setiform, characteristically curved notogastral setae present, setae c_2 much shorter than the others, hardly visible.

Lateral part of podosoma: Exobothridial region smooth, without granules or small tubercles, but well sclerotised. A large protuberance behind the bothridium and a longitudinal crest bearing exobothridial setae observable (Fig. 36). Pedotecta 1 clearly visible.

Ventral parts (Fig. 35): Epimeral region clearly delimited laterally by a pair of longitudinal crests, its surface with irregular pattern. Apodemes and epimeral borders (except *bo.4*) well-developed, but anterior part of sternal apodeme reduced, *bo. 4* absent. One pair of strong tubercles visible in sejugal region bearing setae *3b*. Epimeral setae varying in length. Five pairs of genital, one pair of aggenital, two pairs of anal setae, setae ad_3 setae short, ad_1 and ad_2 much longer. Lyrifissures *iad* in direct apoanal position.

Legs: All of normal oppioid type. Solenidium ϕ_1 situated on a well-developed process of tibia I.

REMARKS: The new species is primarily characterized by the absence of posterior epimeral borders, by its prodorsal sculpture, and by the single pair of ventral sejugal tubercles. On this basis it is closely related to the genus *Subiasella* (*Lalmoppia*)



FIGS 34-36

Subiasella (Lalmoppia) khaolak sp. n. (34) Body in dorsal view. (35) Body in ventral view. (36) Body in lateral view.

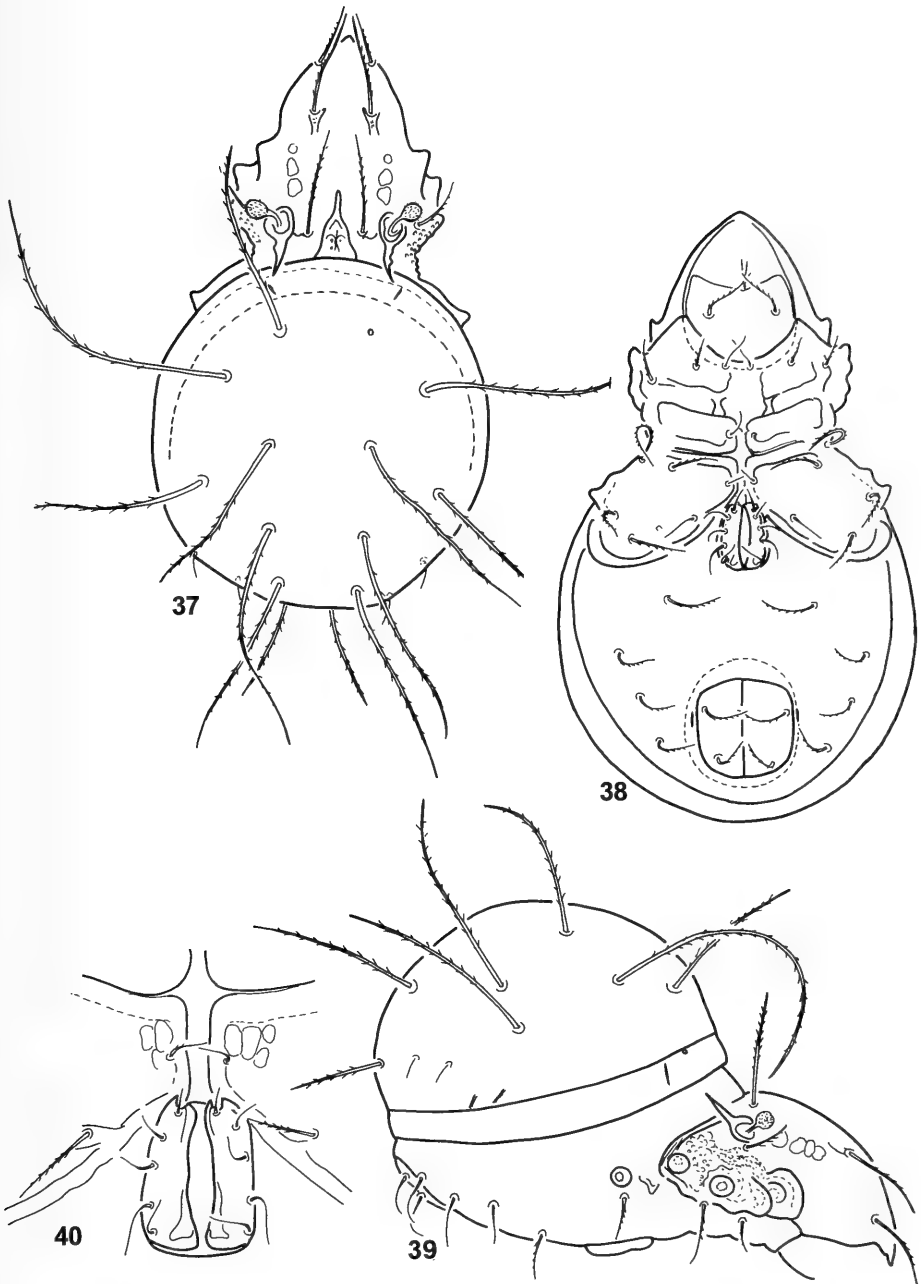
Subias & Rodriguez, 1986. In the form of its prodorsal costula and sensillus, and in its large sejugal tubercles *Subiasella (Lalmoppia) khaolak* sp. n. is distinct from its relatives.

ETYMOLOGY: The new species is named after its type locality.

***Vietoppia insitiva* sp. n.**

Figs 37-40

MATERIAL EXAMINED: Holotype: Thailand, Phang Nga Prov., Khao Lak National Park, Tone Chong Fa Waterfall, 100-300 m, Winkler extraction in primary moist forest with secondary spots, 6.-15. I. 1998, leg. A. Schulz & K. Vock (As-T-3). 1 paratype in the same sample. Holotype deposited in MHNG, paratype (1764-PO-2008) in HNHM.



FIGS 37-40

Vietoppia insitiva sp. n. (37) Body in dorsal view. (38) Body in ventral view. (39) Body in lateral view. (40) Genital region.

DIAGNOSIS: Rostrum conical. A pair of short lamellar costulae and basally an unpaired lanceolate crest observable. Bothridium with a long, spiniform extension directed backwards. Sensillus short, its head round. Notogaster strongly arched. Ten pairs notogastral setae, setae c_2 represented only by their alveoli, setae ps_2 and ps_3 fine, very short, all others very long, curved and setiform. Epimeral setal formula: 3 - 1 - 3 - 3, genito-anal setal formula: 5 - 1 - 2 - 3. Adanal setae in para-anal or pre-anal position.

MEASUREMENTS: Length of body 510-582 μm , width of body 312-325 μm , height of notogaster 264 μm .

DESCRIPTION: *Prodorsum:* Rostral apex pointed, beak-shaped in lateral view. Costulae reduced, only their blunt cusp observable, bearing lamellar setae. Some (mostly 4) pairs of spots laterally on the prodorsal surface and an unpaired lancetiform structure located in the interbothridial region basally (Fig. 37). Bothridium with a peculiar, long, narrow and sharply pointed expansion directed backwards. Peduncle of sensillus short and curved, its head round, aciculate. All prodorsal setae setiform, ciliate, their ratio $ex < ro < le < in$.

Notogaster: Very high, hemispherical (Fig. 39). Ten pairs of notogastral setae present, among them setae c_2 vestigial, ps_2 and ps_3 short, very fine, filiform and smooth, seven pairs of long, setiform: setae lm the longest, setae ps_1 the shortest of all, lm directed forwards. All these seven pairs of setae distinctly ciliate.

Lateral part of podosoma: Exobothridial region granulate (Fig. 39). Pedotecta 1 roundish, pedotecta 2-3 reduced, discidium large.

Ventral parts: Epimeral region strongly sclerotised, but apodemes partly reduced (Fig. 38). Epimeres partly not touching each other, sternal region delimited by thick crests medially on both sides. Sejugal borders double, very thick. Posterior borders of epimeral region curved. Infracapitulum large, setae h robust. Among the epimeral setae three inner pairs thin, filiform, all others much thicker and distinctly ciliate. Genital aperture small, narrow, much smaller than anal aperture. Genital plates incised anteriorly (Fig. 40), anterior setae situated on them. All setae thin, smooth, comparatively long. Aggenital, anal and adanal setae similar in length, distinctly ciliate. No adanal setae in postanal position, setae ad_3 situated far anteriorly and laterally (Fig. 38). Lyrifissures iad located in adanal position, very close to anal aperture.

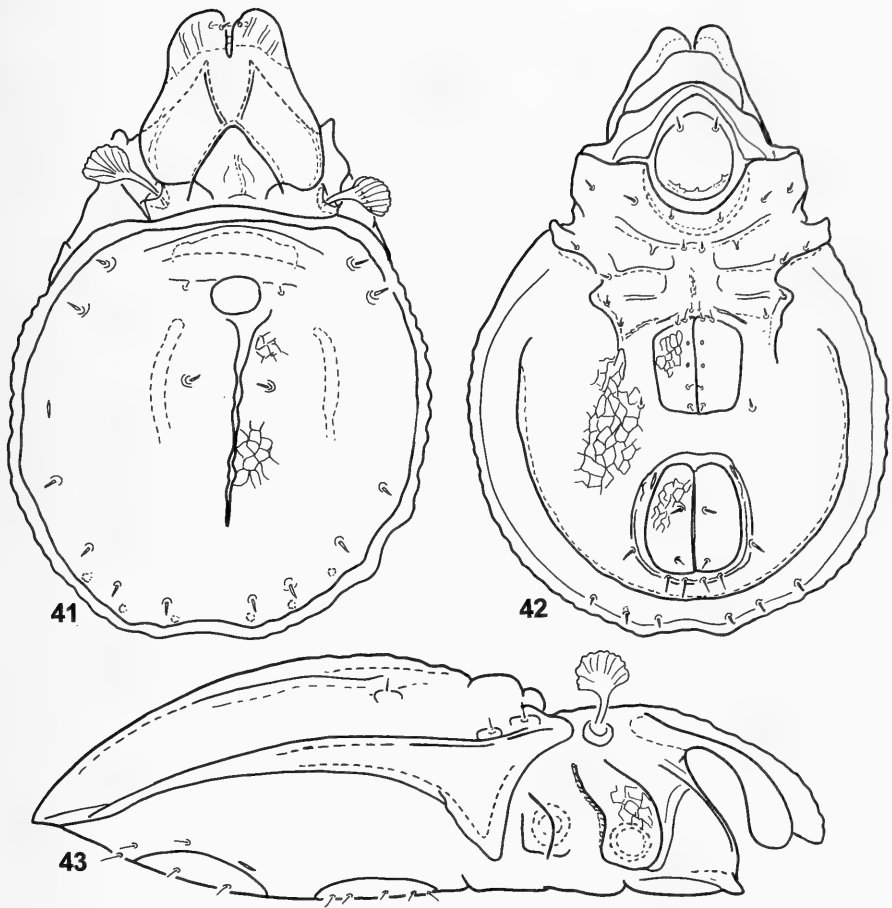
REMARKS: The new species is well characterised first of all by the position of its adanal setae and lyrifissures, by the shape of the body, and by the number and shape of the notogastral setae. On the basis of these characters the new species can be placed in the genus *Vietoppia* Balogh & Mahunka, 1968. However, some features, e.g. the presence of the costular apex, the interbothridial projection and the form of the bothridium, distinguishes it from the related species. These features need further study.

ETYMOLOGY: The species name refers to the peculiar bothridial characteristic which is not known to exist in other species of the family Oppiidae.

Mahunkaia schwendingeri sp. n.

Figs 41-43

MATERIAL EXAMINED: Holotype: Thailand, Phang Nga Prov. & city, near Tapan Cave, 20 m (soil at base of limestone cliff), 9. IX. 2004, leg. P. Schwendinger (TH-04/17). Holotype deposited in MHNG.



FIGS 41-43

Mahunkaia schwendingeri sp. n. (41) Body in dorsal view. (42) Body in ventral view. (43) Body in lateral view.

DIAGNOSIS: Body flat, notogaster becoming thinner posteriorly, its surface covered with a cerotegument layer. Lamellae covering anterior part of prodorsum; lamellar setae short, situated on margin of lamellar cusps. Interlamellar setae absent; sensillus clavate, very broad. Notogaster rounded, with undulating posterior margin. Ten (maybe eleven) pairs of short, spiniform notogastral setae present. Lenticulus rounded, in front of it a large protuberance, behind it a deep split (?) present. Ventral plates and surface of genital and anal plates with polygonate pattern. All setae spiniform, short, adanal setae situated on a semicircular crest. Legs tri- and heterodactylous.

MEASUREMENTS: Length of body 407 μm , width of body 291 μm .

DESCRIPTION: *Prodorsum:* Lamellae large, rounded anteriorly and laterally, covering almost the entire prodorsal surface, leaving free only its basal part. This part

with weak ridges. Short and spiniform lamellar setae situated on inner margin, interlamellar setae reduced. Head of the sensillus large, fan-shaped (Fig. 43).

Notogaster: Dorsosejugal region convex medially, pteromorphae large, rounded in dorsal, liguliform in lateral view. Notogaster peculiarly flattened in lateral view, rounded, lateral margin undulating, posterior margin with deep pits in dorsal view (Fig. 41). A large, distinctly protruding protuberance behind the anterior margin. Inner surface with deep fissure and two pairs of depressed fields, mostly with polygonal pattern. Lenticulus broad, wider than long. Six pairs of larger spiniform, short and thin notogastral setae in dorsal view, one pair of hardly observable setae next to lenticulus, and three pairs of posteromarginal (*p*) setae in ventral position. Lyrifissures normal.

Lateral part of podosoma: Pedotecta 1 very large, its surface polygonate. Pedotecta 2 small, triangular. Tutorium narrow, consisting of curved laths.

Ventral parts: Infracapitulum of galumnoid type. Setae *h* situated near anterior margin. Epimeral surface with irregular pattern. Apodemes I touching medially, other ones ending far from each other. Epimeral setal formula: 3 - 1 - 2 - 2, all setiform, some minute, hardly observable (*1a*, *4a*). Surface of ventral plate distinctly polygonate (Fig. 42), with some ridges around genital and anal openings. Genito-anal setal formula: 6 - 1 - 2 - 3, all setae short and thin. Adanal setae situated on ano-adanal crests. Lyrifissures *iad* located at anterior edge of anal plates.

Legs: Strongly damaged, only tarsi of leg II visible. This tri- and heterodactylous, with median claw much thicker and larger than the two lateral ones.

REMARKS: On the basis of the peculiar flattened body and the spiniform notogastral and ventral setae, the new species can be placed in the genus *Mahunkaia* Schatz, 2002. The new species is clearly distinguishable from the other species of this genus by the shape of its sensillus and lenticulus, by the polygonate sculpture of the ventral, genital and anal plates, and by the position of the adanal setae (see Schatz, 2002). All previously known species of the genus were described from the Ethiopian Region.

ETYMOLOGY: I dedicate the new species to Dr. P. Schwendinger, the curator of the arthropod collections of the Muséum d'histoire naturelle, Geneva, who took many very interesting soil samples and provided this Oribatida material for examination.

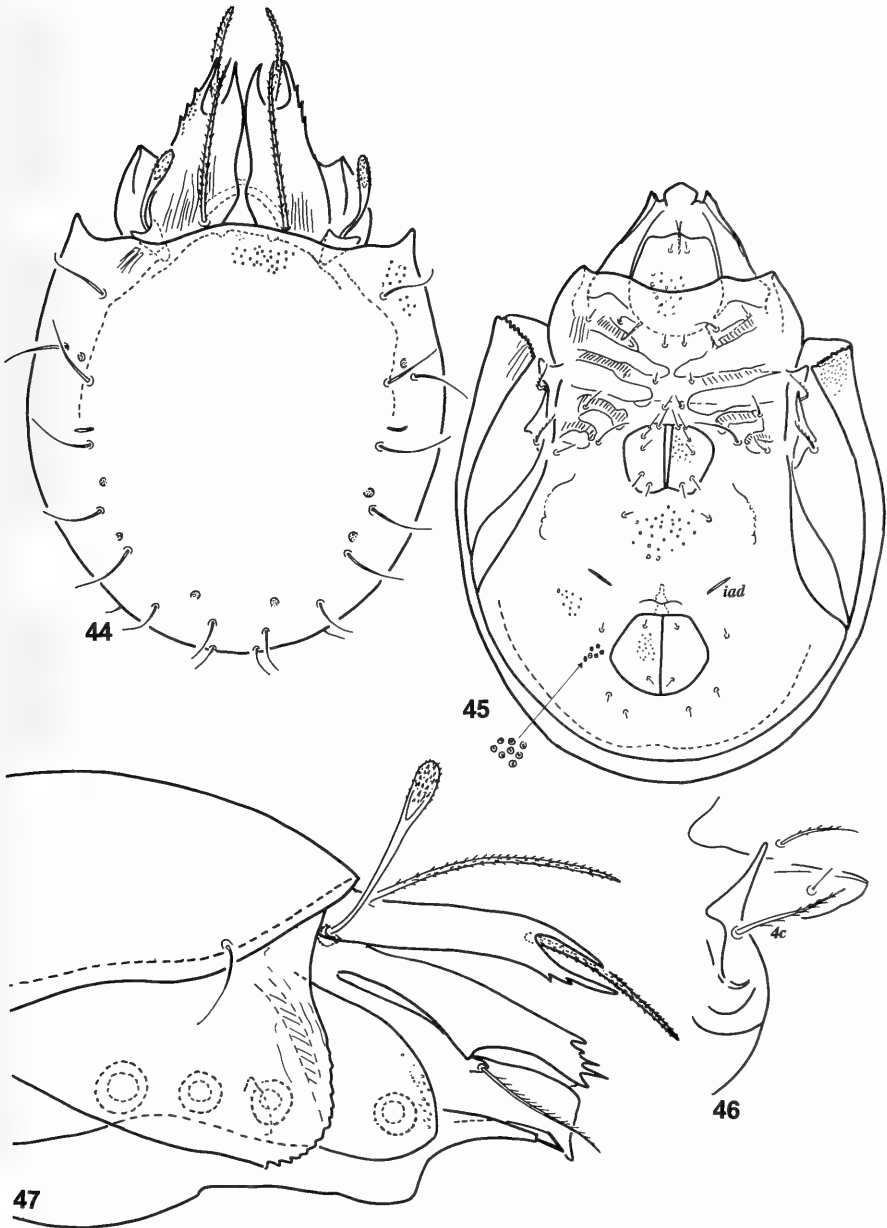
***Oribatella zsilavii* sp. n.**

Figs 44-47

MATERIAL EXAMINED: Holotype: Thailand, Phetchaburi Prov., Kaeng Krachan National Park, 450 m, 19. XI. 1985, leg. D. Burckhardt & I. Löbl (TH-26). 9 paratypes in the same sample. Holotype and 5 paratypes deposited in MHNG, 4 paratypes in HNHM.

DIAGNOSIS: Rostrum without median incisure. Lamellae long, median and lateral cusps nearly equal in length. Lamellar knob absent, lamellae disconnected basally. Sensillus long, longer than pedotecta 1. Surface of notogaster and ventral regions foveolate, foveolae mostly with distinct median puncture. Ventral setae simple, short, spiniform. Setae *4c* moderately long, directed inwards, setiform. Ventral plates and part of epimeral surface ornamented with foveolae like the notogastral ones. Infracapitulum, genital and anal plates with simple foveolae. All legs monodactylous.

MEASUREMENTS: Length of body 306-327 μm , width of body 214-221 μm .



FIGS 44-47

Oribatella zsilavii sp. n. (44) Body in dorsal view. (45) Body in ventral view. (46) Lateral part of epimeral region with discidium and custodium. (47) Anterior part of podosoma in lateral view.

DESCRIPTION: *Prodorsum*: Rostrum convex. Lamellae large, lamellar cusps equal in length (Fig. 44), outer cusp with three to four small teeth laterally. Lamellae with long inner margin not connected to each other, lamellar knob absent, only a weak

transversal crest visible. Lamellar surface punctate anterolaterally and rugose basally. Interlamellar setae long, thinner than lamellar ones. Sensillus (Fig. 47) clavate, very long, longer than pedotecta 1.

Notogaster: Anterolateral margin of pteromorphae distinctly serrate and foveolate. Notogastral surface punctate in dorsosejugal part, foveolate posteriorly. Ten pairs of notogastral setae present, all roughened, their length varying, setae *ps* shorter than the others. Four pairs of clearly developed porose areas also well observable.

Lateral part of podosoma: Tutorium narrow, with three to four long, narrow and two to three short dens (Fig. 47) present. Genal tooth triangular. Pedotecta 1 very large, covering the whole acetabulum. Discidium narrow, custodium long, but much shorter than setiform, distinctly ciliate setae *4c*.

Ventral parts (Fig. 45): Infracapitulum irregularly punctate. Setae *h* short, setiform. Epimeral surface partly ornamented with foveolae with a median point. This sculpture visible also on ventral plate. Epimeral setae (except *3c* and *4c*) short, simple. Setae *4c* the longest of all (Fig. 46), setae *3c* also longer than the other ones. Surface of genital and anal plates ornamented with simple foveolae. Genital and aggenital setae simple. Anal and adanal setae very short. Lyrifissures *iad* located very far anteriorly, in direct apoanal position.

Legs: All legs monodactylous.

REMARKS: The new species is well characterized by lacking an interlamellar tooth, by its notogastral and ventral sculpture, the serrated margin of its pteromorphae, and by its monodactylous legs. On the basis of this combination of features, the new species is closest to *Oribatella sculpturata* Mahunka, 1987. However, the inner and outer lamellar apices are equal in length in *zsilavii* sp. n. (of different length in *sculpturata*) and the lyrifissures *iad* are situated in front of the anal aperture in *zsilavii* (located near the anterior margin in *sculpturata*).

ETYMOLOGY: I dedicate the new species to Dr. Fábian Zsilavi (Hedervár, com. Győr-Spron, Hungary) for his help in my work.

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REFERENCES

- AOKI, J. 1965. Oribatiden (Acarina) Thailand. I. *Nature and Life in SE Asia* 4: 129-193.
 AOKI, J. 1968. Oribatiden (Acarina) Thailand. II. *Nature and Life in SE Asia* 5: 189-207.
 AOKI, J. 1977. Three species of the genus *Eohyponchthonius* from Japan. *Acarologia* 19(1): 117-122.
 CORPUZ-RAROS, L. A. & GARCIA, R. C. 2003. Three new species and five new records of primitive oribatids from the Philippines (Acari: Oribatida). *Asia Life Sciences* 21(1): 1-18.

- GRANDJEAN, F. 1954. Essai de classification des oribates (acariens). *Bulletin de la Société Zoologique de France* 78: 421-446.
- GRANDJEAN, F. 1965. Complément à mon travail de 1953 sur la classification des Oribates. *Acarologia* 7: 713-734.
- MAHUNKA, S. 1988. New and interesting mites from the Geneva Museum LXI. Oribatids from Sabah (East Malaysia) III (Acari: Oribatida). *Revue suisse de Zoologie* 95(3): 817-888.
- MAHUNKA, S. 1994. Two new galumnid species (Acari: Oribatida) from Thailand. *Acta Zoologica Academiae Scientiarum Hungaricae* 40(4): 351-357.
- MAHUNKA, S. 1995a. *Christovizetes prasadi* sp. n., a new microzetid species from Thailand (Acari: Oribatida). *Journal of International Acarology* 21(4): 239-242.
- MAHUNKA, S. 1995b. New oribatids (Acari: Oribatida) from Thailand. *Acta Zoologica Academiae Scientiarum Hungaricae* 41(2): 137-145.
- MAHUNKA, S. 2008. A new genus and some other data of oribatids from Thailand (Acari: Oribatida). *Acta Zoologica Academiae Scientiarum Hungaricae* 54(2): 125-150.
- MAHUNKA, S. & MAHUNKA -PAPP, L. 1994. A report on the first Hungarian zoological collecting trip to Thailand. *Folia entomologica hungarica* 55: 263-270.
- MAHUNKA, S. & MAHUNKA-PAPP, L. 2001. Oribatids from Switzerland V (Acari: Oribatida: Suctobelbidae 2.). (Acarologica Genavensia XCVII). *Revue suisse de Zoologie*, 108: 355-385.
- MARSHALL, V. G., REEVES, R. M. & NORTON, R. A. 1987. Catalogue of Oribatida (Acari) of continental United States and Canada. *Memoirs of the Entomological Society of Canada*, 139: I-VI, 1-418.
- NIEDBAŁA, W. 1992. Phthiracaroidea (Acari, Oribatida) systematic studies. PWN - Polish Scientific Publishers, Warszawa, 612 pp.
- NIEDBAŁA, W. 2000. The ptyctimous mites fauna of the Oriental and Australian region and their centres of origin (Acari, Oribatida). *Genus* supplement 1: 1-493.
- NIEDBAŁA, W. 2006. Supplement to the knowledge of Ptyctimous mites (Acari: Oribatida) from Australian Region. *Annales Zoologici* 56 (supplement 1): 99-156.
- NIEDBAŁA, W. & CORPUZ-RAROS, L. A. 1998. Ptyctimous mites (Acari: Oribatida) from the Philippines. *The Philippine Agriculturist* 18(1-2): 1-58.
- NORTON, R. A., ALBERTI, G., WEIGMANN, G. & WOAS, S. 1997. Porose integumental organs of oribatid mites (Acari, Oribatida). 1. Overview of types and distribution. *Zoologica* 146: 1-33.
- SCHATZ, H. 2002. *Mahunkaia* n. gen. (Acari Oribatida Eremaezetidae) from Africa. *Tropical Zoology* 15: 105-120.
- SUBÍAS, L. S. 2004. Listado sistemático, sinonímico y biogeográfico de los ácaros oribátidos (Acariformes, Oribatida) del mundo (1758-2002). *Graellsia* 60: 3-305.
- WEIGMANN, G. 2006. Hornmilben (Oribatida). *Die Tierwelt Deutschlands* 76: 1-520.
- WOAS, S. 2002. 4. 1. Acari: Oribatida (pp. 21-291). In: ADIS, J. (ed.). Amazonian Arachnida and Myriapoda. *Pensoft Publishers, Sofia and Moscow*.

***Crenicichla tesay*, a new species of cichlid (Perciformes: Labroidei) from the río Iguazú basin in Argentina**

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***Crenicichla tesay*, a new species of cichlid (Perciformes: Labroidei) from the río Iguazú basin in Argentina.** - *Crenicichla tesay* sp. n. differs from its congeners by the following combination of characters: posterior border of preopercle serrated, 48-59 scales on E1 row, snout length 2.6-2.8 times in head length, presence of conspicuous suborbital stripe, flanks with 4 to 6 blotches below the upper lateral line, posteriormost blotch extending on caudal peduncle. Colour pattern with numerous irregularly scattered dots, and absence of vertical stripes on flanks.

Keywords: Neotropical - Cichlidae - *Crenicichla* - Argentina - freshwater fish - new species.

INTRODUCTION

The río Iguazú is a tributary of the río Paraná that originates at the Serra do Mar in Brazil. This river runs in an east-west direction for 1,320 km of which the final 115 km flow between the Argentina and Brazil border. About 32 km before it joins the río Paraná, the Iguazú falls produce a 78 m high drop (Severi & Cordeiro, 1994). These falls have been an effective fish-fauna barrier since their formation in the Oligocene-Miocene period.

The poorness of the fish fauna of the río Iguazú was noted by Haseman (1911) and Godoy (1979); however, very few studies have focused on its ichthyofauna. Out of seventy five species that have been recorded for the río Iguazú basin, 60% are endemic (Agostinho *et al.*, 2005). However this number is probably an underestimation, given the description of several new species in recent years (Garavello, 2005; Casciotta *et al.*, 2006a; 2006b; Garavello & Shibatta, 2007).

The genus *Crenicichla* inhabits tropical, subtropical and temperate Cis-Andean environments from Northern South America to río Negro, in Patagonia, Argentina (Casciotta, 1987). *Crenicichla* comprises about 78 species and represents the most speciose genus of cichlid fishes (Kullander & Lucena, 2006). In spite of this great number of species, only two *Crenicichla* species have been recorded in the río Iguazú basin *C. iguassuensis* Haseman, 1911 and *C. yaha* Casciotta *et al.*, 2006. The number of species of *Crenicichla* in the río Iguazú could increase in the future if some *C. iguassuensis* morphs are given species status (Renesto *et al.*, 2001 and Mizoguchi *et al.*, 2007).

The aim of this paper is to describe a new species of the genus *Crenicichla* from tributaries of the río Iguazú upstream from Iguazú falls (Fig. 1).

MATERIAL AND METHODS

Specimens were cleared and counterstained (C&S) following the method of Taylor & Van Dyke (1985). Measurements and counts were taken as described by Kullander (1986). Pharyngeal teeth description and counts of frashed zone concavities follow Casciotta & Arratia (1993). Holotype values are indicated by an asterisk. Body length is expressed as standard length (SL). E1 scale counts refer to the scales in the row immediately above that containing the lower lateral line (Lucena & Kullander, 1992).

Institutional abbreviations are as listed in Leviton *et al.* (1985), except for AI (Asociación Ictiológica, La Plata, Argentina) and PNI (Parque Nacional Iguazú, Misiones, Argentina).

Comparative material: A list of comparative material of *Crenicichla niederleini*, *C. scottii*, *C. vittata* and *C. celidochilus* is available in Casciotta (1987).

In addition, the following material was studied: *Crenicichla hadrostroma*: Argentina. AI 220, 1 ex., 72.8 mm, Misiones, Itacaruaré, río Uruguay basin. *Crenicichla iguassuensis*: Brasil. FMNH 54159 (holotype), 137 mm, Porto União da Victoria, Rio Iguassu. *Crenicichla jupiaensis*: Argentina. AI 226, 2 ex., 87.7-93.0 mm, Corrientes, río Paraná at Yahapé. AI 227, 1 ex., 60.7 mm, Corrientes, río Paraná at Yahapé. *Crenicichla lepidota*: Argentina. MACN-ict 5067, 4 ex., 67.7-113.4 mm, Misiones, Represa Estación Experimental Cerro Azul. FML 00528, 1 ex., 111.5 mm, Salta, Luna Muerta, Hickman. MACN-ict 3656, 2 ex., 116.0-165.7 mm, Formosa, Riacho de Oro. MACN-ict 7275, 1 ex., 151.6 mm, Chaco, Esteros del Palmar. FML 00312, 1 ex., 138.0 mm, Corrientes, Isla Apipé Grande, Ituzaingó. MACN-ict 4091, 1 ex., 98.4 mm, Entre Ríos, río Uruguay, Concepción del Uruguay. MACN-ict 2314, 6 ex., 59.9-104.2 mm, Buenos Aires, Isla Martín García. Uruguay. MNHN 2087, 1 ex., 72.9 mm, Departamento Colonia, arroyo Limetas. *Crenicichla semifasciata*: Argentina. MACN-ict 3683, 1 ex., 68.8 mm, Formosa, Riacho de Oro. MACN-ict 6239, 1 ex., 176.6 mm, Entre Ríos, arroyo Curupí. *Crenicichla ocellata*: Paraguay. MSNG 33700 (holotype), 257.5 mm, Puerto 14 de Mayo, Bahía Negra, Chaco Boreal. *Crenicichla yaha*: Argentina. Misiones Province. MACN-ict 8924 (holotype), 103.7 mm, arroyo Urugua-í in Isla Palacios. AI 199, 1 ex., 116.6 mm, río Iguazú basin, arroyo Benavente. MTD-F 30606 (paratype), 1 ex., 105.9 mm, arroyo Urugua-í in ruta provincial 19, Parque Provincial Islas Malvinas. AI 200 (paratype), 1 ex., 135.8 mm SL, arroyo Urugua-í (affluent of A. Urugua-í) in ruta provincial 19, Parque Provincial Islas Malvinas. AI 202 (paratypes), 4 ex., 1 (C&S) 37.4-48.5 mm, arroyo Urugua-í in Isla Palacios.

RESULTS

Crenicichla tesay sp. n.

Figs 1-4, Table 1

HOLOTYPE: MACN-ict 9016, 115.1 mm, Argentina, Misiones, río Iguazú basin, arroyo Verde (25°40'15.0"S-53°56'00.8"W), coll: F. Nuñez, February 2002.

PARATYPES: All from Argentina. MACN-ict 9017, 1 ex., 124.2 mm, Misiones, río Iguazú basin, arroyo Deseado (25°47'08.1"S-54°01'45.0"W), coll: F. Nuñez, February 2002. MACN-ict

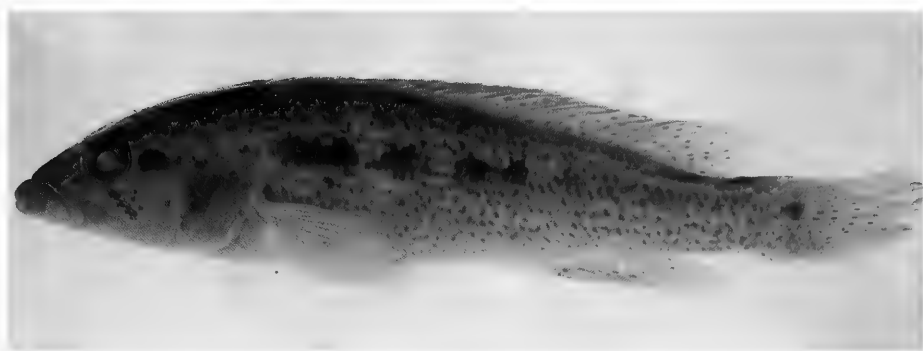


FIG. 1

Crenicichla tesay sp. n., holotype: MACN-Ict 9016, 115.1 mm SL, Argentina, Misiones, río Iguazú basin, arroyo Verde.

9018, 5 ex., 55.7-252.0 mm, Misiones, río Iguazú basin, arroyo Tateto (25°47'12.8"S-53°58'12.9"W), coll: F. Nuñez, February 2001. MHNG, 2708.062, 3 ex., 86.9-119.5 mm, same data as holotype. AI 213, 1 ex., 156.7 mm, Misiones, río Iguazú basin, arroyo Deseado Chico (in road 101) (25°47'19.7"S-54°01'45.0"W), coll: F. Nuñez, February 2002. AI 214, 4 ex., 75.8-116.6 mm, Misiones, río Iguazú basin, arroyo Tateto (25°47'12.8"S-53°58'12.9"W), F. Nuñez, February 2001.

NON-TYPES SPECIMENS: Argentina, Misiones Province. AI 215, 1 ex., C&S 69.0 mm, río Iguazú basin, arroyo Tateto (25°47'12.8"S-53°58'12.9"W), coll: F. Nuñez, February 2001. MLP 6-III-49-6- 7, 2 ex., 97.0-133.0 mm, alto río Iguazú. PNI unreg., 1 ex., 103.2 mm, Parque Nacional Iguazú, arroyo Ñandú. PNI unreg., 1 ex., 267.7 mm, Misiones, arroyo Ibicui.

DIAGNOSIS: *Crenicichla tesay* is distinguished from the other species of the genus by the following combination of characters: posterior border of preopercle serrated, 48-59 scales on E1 row, snout length 2.6-2.8 times in head length, presence of conspicuous suborbital stripe, flanks with 4 to 6 blotches below the upper lateral line, posteriormost blotch extending on caudal peduncle. Colour pattern with numerous irregularly scattered dots and absence of vertical stripes on flanks.

DESCRIPTION: Body elongate, depth four to five times in SL (Fig. 1). Head slightly deeper than wider. Snout short, bluntly pointed in lateral view. Jaws isognathous or lower jaw slightly prognathous. Maxilla almost reaching anterior margin of orbit. Lower lip folds widely separated anteriorly. Nostrils dorsolateral, nearer anterior margin of orbit than snout tip. Posterior margin of preopercle serrated (smooth in one specimen). Scales on flank strongly ctenoid. Head scales cycloid. Predorsal scales small, superficially embedded in skin. Prepelvic scales smaller than predorsal ones. Cheek scaled, 6 to 7 scales below eye embedded in skin. Scales in E1 row 48(1), 52(1), 53(3), 55(4*), 56(1), 57(2), 58(1), 59(2). Scales in transverse row 11/14(1), 11/16(3), 12/14(1*), 12/15(2), 12/16 (4), 12/17(2), 12/18(1). Three scale rows between lateral lines. Upper lateral line scales slightly larger than the adjacent scales 22(1), 23(1), 24(6*), 25(3), 26(2), 27(1), 28(1). Lower lateral line scales equally in size than adjacent ones 7(1), 10(1), 13(4*), 14(2), 15(5), 16(2). Dorsal, anal, pectoral and pelvic fins naked. Dorsal fin XXI,11(3*), XXI,12(2); XXII,9(1); XXII,11(4); XXII,12(5). Anal fin III,8 (4*); III,9(11). Pectoral fin 17(9), 18(6*). Caudal fin squamation

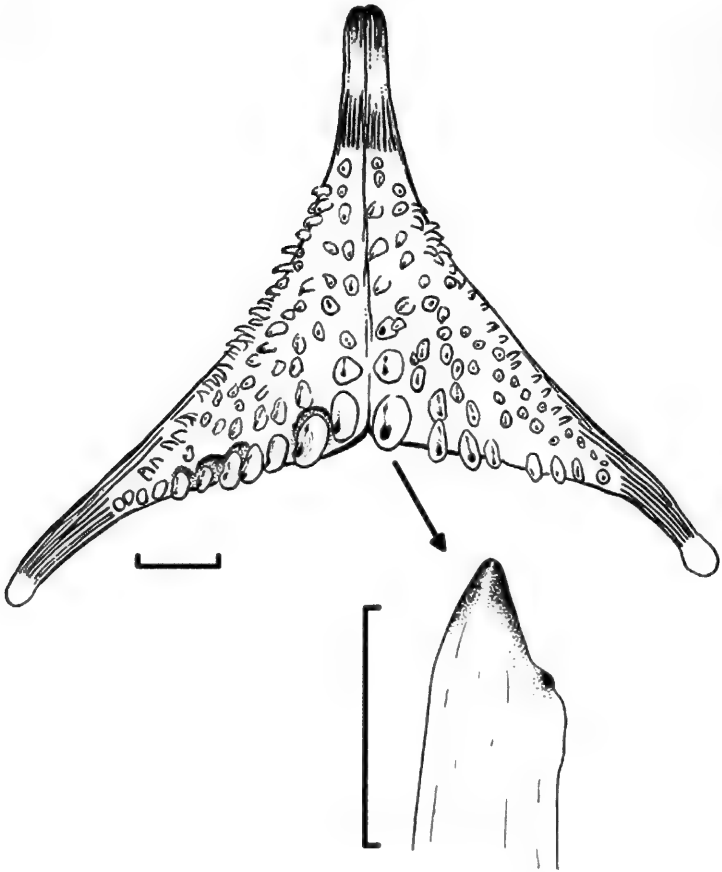


FIG. 2

Crenicichla tesay sp. n., lower pharyngeal tooth plate in occlusal view, AI 215, 69.0 mm SL. Scale bar: 1 mm.

extending almost to middle of fin. Soft-dorsal fin rounded or pointed tip, reaching or scarcely surpassing the caudal-fin base. Soft-anal fin not reaching the caudal-fin base. Caudal fin rounded. Pectoral fin rounded, reaching 75% of pelvic-fin length. Microbranchiospines present on second trough fourth gill arches. Nine gill rakers on ceratobranchial. Four or six patches of unicuspidate teeth on fourth ceratobranchial. Lower pharyngeal tooth plate with unicuspidate recurved and bicuspidate crenulated curved anteriorly teeth, those of posterior row much larger than the remaining ones (Fig. 2). Upper pharyngeal tooth plate with unicuspidate and bicuspidate teeth. Frashed zone bearing one concavity with small unicuspidate teeth. Premaxillary ascending process longer than dentigerous one. Premaxilla with 28 unicuspidate teeth on outer row, larger than the inner ones. Five teeth rows near symphysis. Dentary with 30 unicuspidate teeth on outer row, 4 rows near symphysis. Total vertebrae: 38 (1 C&S ex.). Premaxillary and dentary outer row teeth slightly movable or fixed, inner ones fully depressible.

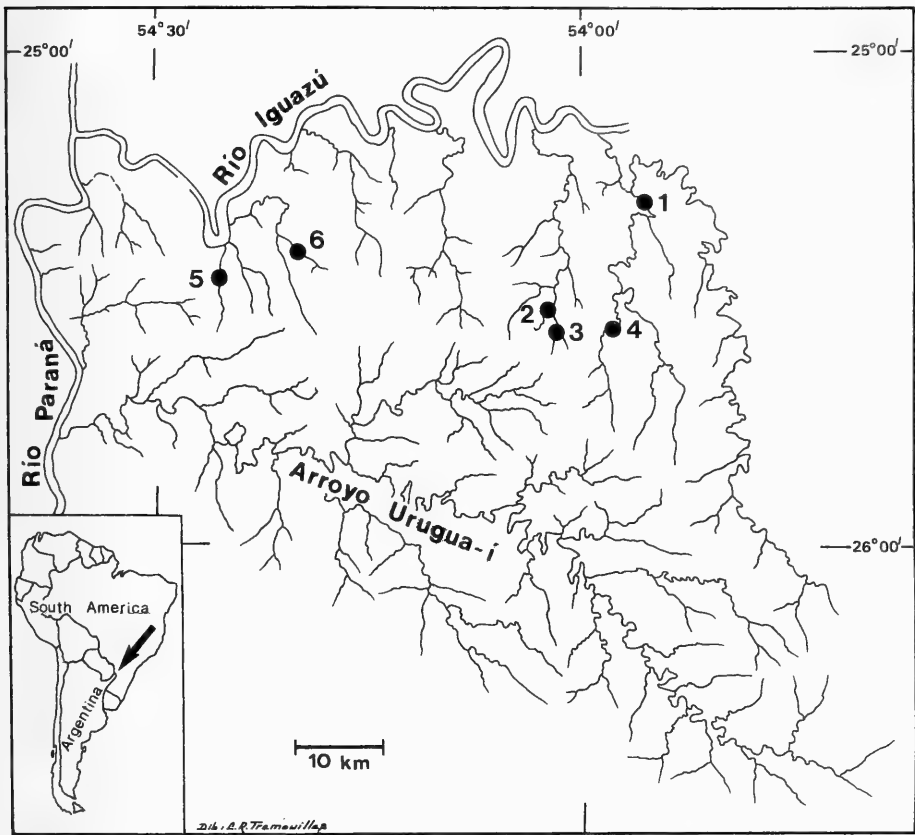


FIG. 3

Geographical distribution of *Crenicichla tesay* sp. n.: 1, arroyo Verde (type locality); 2, arroyo Deseado; 3, arroyo Deseado Chico; 4, arroyo Tateto; 5, arroyo Ñandú; 6, arroyo Ibicui.

COLOUR IN ALCOHOL: There is no obvious sexual dichromatism. Lateral line scales lighter than the adjacent ones. Grey preorbital stripe between anterior margin of orbit to snout tip, more conspicuous in smaller specimens (55.7-81.4 mm SL). Wide and greyish, postorbital stripe between posterior margin of orbit to preopercle distal margin, only one specimens with postorbital stripe reaching tip of opercle (75.8 mm SL). Suborbital stripe black, reaching almost the ventral margin of cheek, proximally entire, distally fragmented. Nuchal markings faint in adults, more conspicuous in smaller specimens. Flank with numerous irregularly scattered dark dots; few dots on cheek and opercular region in four specimens. Four to six dark rectangular or sub-circular blotches just below the upper lateral line. Posteriormost blotch extending onto caudal peduncle, except in one specimen. Dorsal, anal, and caudal-fins smoky, with numerous dark scattered dots on their surface. Caudal fin with a black subcircular spot well separated from the base of the fin, just above of midline of caudal fin. That spot bears a narrow light ring. Pectoral fin smoky, pelvic fin whitish.

ETYMOLOGY: The specific epithet *tesay*, a noun in apposition, is a Guaraní word that means tears in allusion to the shape of suborbital stripe.

DISTRIBUTION: *Crenicichla tesay* inhabits streams tributaries of the río Iguazú above Iguazú falls in Argentina (Fig. 3).

HABITAT: The depth of the streams was variable, averaging about 80 cm. The bottom was composed of mud, sand and mostly stones, and the stream has falls and pools, with clear, rapidly flowing water. Some areas had scarce submerged vegetation (Fig. 4).

COMPARISON OF SPECIES: Thirteen species of *Crenicichla* have been recorded from freshwater environments in Argentina (Casciotta, 1987; Casciotta *et al.*, 2007; Lucena, 2007; Lucena & Kullander, 1992): *C. celidochilus* Casciotta, 1987; *C. gaucho* Lucena & Kullander, 1992; *C. hadrostigma* Lucena, 2007; *C. jupiaensis* Britski & Luengo, 1968; *C. lepidota* Heckel, 1840; *C. minuano* Lucena & Kullander, 1992; *C. missioneira* Lucena & Kullander, 1992; *C. niederleinii* (Holmberg, 1891); *C. scottii* (Eigenmann, 1907); *C. semifasciata* (Heckel, 1840); *C. tendybaguassu* Lucena & Kullander, 1992; *C. vittata* Heckel, 1840; and *Crenicichla yaha* Casciotta *et al.*, 2006.

Crenicichla tesay differs from *C. celidochilus*, *C. tendybaguassu*, *C. minuano*, and *C. missioneira* by having preopercle serrated and a suborbital stripe vs. preopercle smooth and suborbital stripe absent or reduce. *Crenicichla tesay* can be distinguished from *C. vittata* by E1 row scales counts, 48-59 vs. 78-85.

The flanks of the new species *C. tesay* have numerous small dots and rectangular or subcircular blotches just below the upper lateral line, a combination of features not present in *C. jupiaensis*, *C. lepidota*, *C. niederleinii*, or *C. scottii*. Besides, *C. lepidota* has humeral spot, *C. scottii* has flanks with several regular parallel rows of small dark spots, *C. niederleinii* bears narrow vertical bars and a lateral band on the flank, and *C. jupiaensis* bears 14 to 17 narrow vertical bars; all these characters are absent in *C. tesay*.

Crenicichla tesay is easily distinguished from *C. semifasciata* by having half of the caudal fin scaled and the ascending premaxillary process longer than the denticulous one, vs. an almost completely scaled caudal fin and shorter ascending process. It can be distinguished from *C. gaucho* by the postorbital stripe not reaching the tip of opercle and by the absence of a lateral band (Lucena & Kullander, 1992).

Crenicichla tesay is easily differentiated from *C. hadrostigma* because the latter species bears a conspicuous ocellated posttemporal spot larger than half orbital diameter, which is not found in any other *Crenicichla* species.

Lucena (2007) described *C. empheres* from the rio Uruguay drainage in Brasil. The colour pattern of this species resemble that of *C. tesay*, however the new species can be distinguished from *C. empheres* by having flanks with four to six blotches vs. six to eight, and a well developed suborbital stripe that almost reaches the ventral margin of the cheek vs. either reduced to a spot at margin of orbit or two to five small dots below orbits.

The species *C. lacustris* (Castelnau, 1855), *C. maculata* Kullander & Lucena, 2006, and *C. punctata* Hensel, 1870 from the Atlantic coastal rivers of southeastern Brazil share with *C. tesay* the presence of numerous scattered dots on the flanks.



FIG. 4. Habitat of *Crenicichla tesay* sp. n., arroyo Verde, type locality.

TABLE 1. Morphometry of the holotype and 14 paratypes of *Crenicichla tesay* sp. n. expressed as percentage of SL. SD: standard deviation.

	Holotype	Range	Mean	SD
Standard length (mm)	115.1	55.8-252.7		
Head length	32.0	31.9-36.3	33.1	1.29
Snout length	13.2	11.5-14.3	12.3	0.77
Head depth	17.5	14.0-17.9	16.0	1.06
Body depth	24.4	19.2-24.5	21.5	1.52
Orbital diameter	7.2	4.8-8.4	7.2	1.03
Interorbital width	8.5	5.8-9.3	7.2	0.92
Pectoral fin length	22.9	16.1-22.9	20.5	1.83
Caudal peduncle depth	10.6	9.4-11.6	10.2	0.63
Caudal peduncle length	16.2	15.3-16.9	16.2	0.55

However *C. tesay* differs from those species in having a lower E1 row scales counts. *Crenicichla tesay* can be distinguished from *C. lacustris* by the absence of a continuous lateral band, dark dots on head and E1 row scales counts (48-59 vs. 57-75 [Lucena & Kullander, 1992]). *Crenicichla maculata* has 58-75 scales in the longitudinal series whereas *C. tesay* has 48-59 (Lucena & Kullander, 1992). *Crenicichla punctata* has numerous small dots on the head and 56-70 scales in E1 row (Lucena & Kullander, 1992) whereas most specimens of *C. tesay* lack dots on the head (4 ex. with few of them on cheek and opercular region) and 48-59 scales in the E1 row.

Three species have been recorded from the upper río Paraná in Brazil and were not present in the portion of this river that traverse Argentina: *C. britskii* Kullander, 1982; *C. haroldoi* Luengo & Britski, 1974; and *C. jaguarensis* Haseman, 1911. *Crenicichla britskii* has a humeral spot which is absent in *C. tesay*; *C. haroldoi* has brown dots on each lateral line scale which are absent in *C. tesay*. Finally, *C. jaguarensis* has 6 to 7 gill-rakers on the lower anterior arch and eleven vertical bars whereas *C. tesay* has nine gill-rakers and lacks such bars.

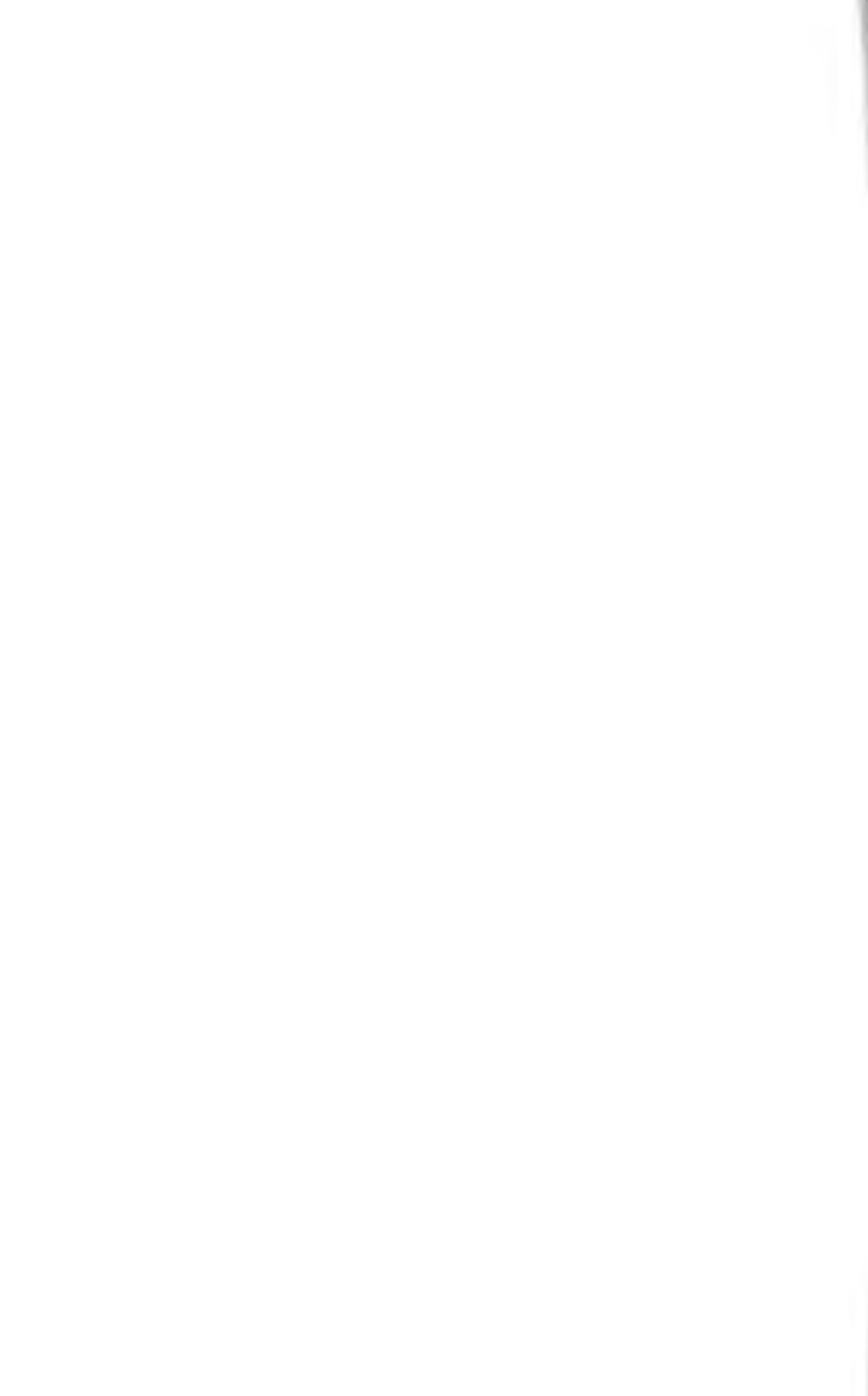
Currently only two *Crenicichla* species have been described from the río Iguazú basin: *C. iguassuensis* Haseman, 1911 from upper portion of this river and *Crenicichla yaha* Casciotta *et al.*, 2006, from the arroyo Benavente, just above the Iguazú falls. *Crenicichla tesay* differs from *C. iguassuensis* by having longer snout (2.6-2.8 vs. 3.0-3.5 in head length), lower number of E1 row (48-59 vs. 54-64), and having rectangular or subcircular blotches on the flank not extended onto its dorsum. Finally, *C. tesay* can distinguished from *C. yaha* by having isognathous jaws or slightly prognathous lower jaws vs. isognathous or slightly prognathous upper jaw; head depth 14.0-17.9 vs. 17.9-20.8 % of SL; and (numerous scattered) dots on the flank which are absent in both sexes of *C. yaha*.

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REFERENCES

- AGOSTINHO, A. A., THOMAZ, S. M., GOMES L. C. 2005. Conservation of the biodiversity of Brazil's inland waters. *Conservation Biology* 19: 646-652.
- CASCIOTTA, J. R. 1987. *Crenicichla celidochilus* N. Sp. from Uruguay and a multivariate analysis of the *lacustris* group (Perciformes, Cichlidae). *Copeia* 1987: 883-891.
- CASCIOTTA, J. R., ALMIRÓN, A. E. & GÓMEZ, S. E. 2006a. A new species of *Australoheros* (Teleostei: Perciformes: Cichlidae) from the río Iguazú basin, Argentina. *Zoologische Abhandlungen* 55: 77-83.
- CASCIOTTA, J. R., ALMIRÓN, A. E. & GÓMEZ, S. E. 2006b. *Crenicichla yaha* sp. n. (Perciformes: Labroidei: Cichlidae), a new species from the río Iguazú and arroyo Urugua-í basins, northeastern Argentina. *Zoologische Abhandlungen* 56: 107-112.
- CASCIOTTA, J., ALMIRÓN, A., BECHARA, J., RUIZ DÍAZ, F., SANCHEZ, S. & GONZÁLEZ, A. 2007. First record of *Crenicichla jupiaensis* Britski & Luengo, 1968 (Perciformes: Cichlidae) in freshwaters of Argentina. *Ichthyological contributions of PecesCriollos* 4: 1-4.
- CASCIOTTA, J. R. & ARRATIA, G. 1993. Jaws and teeth of American Cichlids (Pisces: Labroidei). *Journal of Morphology* 217: 1-36.
- GARAVELLO, J. C. 2005. Revision of genus *Steindachneridion* (Siluriformes: Pimelodidae). *Neotropical Ichthyology* 3: 607-623.
- GARAVELLO, J. C. & SHIBATA, O. A. 2007. A new species of the genus *Pimelodus* La Cépède, 1803 from the rio Iguaçú basin and a reappraisal of *Pimelodus ortmanni* Haseman, 1911 from the rio Paraná system, Brazil (Ostariophysi: Siluriformes: Pimelodidae). *Neotropical Ichthyology* 5: 285-292.
- GODOY, M. P. DE. 1979. Rio Iguaçú, Paraná, Brasil. Reconhecimento da ictiofauna, modificações ambientais e usos múltiplos dos reservatórios. Electrosul, Rio de Janeiro, 33 p.
- HASEMAN, J. D. 1911. An annotated catalog of the cichlid fishes collected by the expedition of the Carnegie Museum to central South America, 1907-10. *Annals of the Carnegie Museum* 7: 329-373.
- KULLANDER, S. O. 1986. Cichlid fishes of the Amazon River drainage of Peru. Swedish Museum of Natural History, Stockholm, 431 pp.
- KULLANDER, S. O & LUCENA, C. A. S. 2006. A review of the species of *Crenicichla* (Teleostei: Cichlidae) from the Atlantic coastal rivers of southeastern Brazil from Bahia to Rio Grande do Sul State, with description of three new species. *Neotropical Ichthyology* 4: 127-146.
- LEVITON, A. E., GIBBS, Jr., R. H., HEAL, E. & DAWSON, C. E. 1985. Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia* 1985: 802-832.
- LUCENA, C. A.S. 2007. Two new species of the genus *Crenicichla* Heckel, 1840 from the upper rio Uruguay drainage (Perciformes: Cichlidae). *Neotropical Ichthyology* 5: 449-456.
- LUCENA, C. A. S. & KULLANDER, S. O. 1992. The *Crenicichla* (Teleostei: Cichlidae) species of the Uruguay River Drainage in Brazil. *Ichthyological Exploration of Freshwaters* 3: 97-160.
- MIZOGUCHI, S. M. H. K., PORTELA-CASTRO, A. L. B. & MARTINS-SANTOS, I. C. 2007. Cytogenetic characterization of *Crenicichla* (Pisces, Perciformes, Cichlidae) of the Iguaçú River. *Genetics and Molecular Research* 6: 650-656.
- RENESTO, E., ZAWADZKI, C. H. & REVALDAVES, E. 2001. Biochemical taxonomy of *Crenicichla* (Pisces: Perciformes: Cichlidae) of the Iguaçú River, Brazil. *Brazilian Archives of Biology and Technology* 44: 15-22.
- SEVERI, W. & CORDEIRO, A. A. M. 1994. Catálogo de peixes da bacia do rio Iguaçú. IAP/GTZ, Curitiba, 128 pp.
- TAYLOR, W. R. & VAN DYKE, G. C. 1985. Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybiurn* 9: 107-119.



Two new species of Chloropidae (Diptera) from Switzerland

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Two new species of Chloropidae (Diptera) from Switzerland. - The two species *Siphunculina ismayi* sp. n. and *Speccafrons genavensis* sp. n. (Diptera, Chloropidae, Oscinellinae) are described, illustrated and compared with morphologically similar species. Short keys are provided for the two genera for the species of the Western Palaearctic Region.

Keywords: Diptera - Chloropidae - *Siphunculina* - *Speccafrons* - new species - Switzerland.

INTRODUCTION

Although Switzerland is located in the middle of Europe, which is the best studied biogeographical area for Diptera of the World, there are still numerous families insufficiently known. This is basically the result of the inadequate collecting effort devoted to "small black flies and mosquitoes" in this country. On the other hand, its fauna is quite diverse because of its central position in Europe with the influence of the fauna of the Mediterranean (in southern Switzerland), Western Europe (in northern Switzerland), Eastern Europe (in the alpine valleys, like the Wallis or the lower Engadine valley), and even some boreal elements have been found in cool and humid places in the Jura mountains and the Alps. It is not surprising that since the publication of the first checklist of the Diptera of Switzerland with 6088 species (Merz *et al.*, 1998) over 650 species were added in the two supplements published since then (Merz *et al.*, 2002, 2007) and over 80 species have been found since then (Merz, unpublished).

A good example of a poorly studied family is the Chloropidae, the grass-flies. They are one of the larger families of Diptera of the World with over 2000 species described, but several times this number is still awaiting naming (Ismay & Nartshuk, 2000). Usually the species are small (wing length less than 3 mm, with the notable exception of genera like *Lipara* or *Platycephala* whose wings are longer than 6 mm), often black, striped yellow and black, or dull grey with unspotted, hyaline wings. The differences between the species in some genera are small (e.g., *Oscinella*, *Meromyza*, *Chlorops*), often needing examination of the genitalia. Another reason for the lack of interest is the fact that they can be sometimes extremely abundant. It is not unusual to pick out over 100 specimens from an insect net after sweeping once through the vegetation, however most specimens of such a sample usually belong to one or two species only. This makes work at the microscope time-consuming (sorting, pinning, labelling,

identifying, etc.) and not attractive for taxonomists. Applied entomologists usually do not have the time to deal with such large numbers of specimens needing many hours of work for an accurate identification. It is understandable that their taxonomy and nomenclature are far from being well known, although some European species are of considerable economic importance in agriculture (*Oscinella frit* (Linné) or *Chlorops pumilionis* (Bjerkander) and some others).

A comprehensive examination of the literature records and the study of most specimens collected in Switzerland up to about 1990 by Dely-Draskovits *et al.* (1993) revealed 113 species for this country. Based on the examination of further material the Swiss Checklist included 136 species (Dely-Draskovits, 1998). Several thousand additional specimens were studied since then, and Merz *et al.* (2005, 2007) added a further 27 species to the list. Currently, 163 species are recorded from Switzerland. Compared with the diversity in Europe (394 species, see Nartshuk, 2007) and the fauna of neighbouring countries it can be expected that over 200 species may eventually be recorded from Switzerland.

Much needs to be discovered about the biology of the species. Most species in Europe are phytophagous with the larvae feeding principally in shoots of Poaceae, but also in some other plants. The species which are considered to be economically damaging to humans belong to this group, as well as species of *Lipara* which induce conspicuous galls on reed (*Phragmites australis*). Some species, however, are saprophagous (in dung, excrement, decaying vegetation, on dead animals), they are predators of egg masses of grasshoppers and spiders, or they feed on small, soft insects. For instance, the larvae of the most abundant species *Thaumatomyia notata* (Meigen) are predators of scale insects (Sternorrhyncha, Coccoidea) and root aphids (Sternorrhyncha, Aphididea). Few species develop in birds' nests or in fungi.

Geneva is a small canton of 282 km², representing thus 0.7% of the surface of Switzerland. The canton is rather flat, ranging from 350-515 m.a.s.l., and highly populated with over 400,000 inhabitants (about 1,485 inhabitants/km²). It is not surprising that its environment is strongly influenced by human activities (agriculture, habitations, management of forests) and the biologically rich habitat is rather restricted (Greppin *et al.*, 2007). Nevertheless, its biogeographical position at the lower end of the Lake of Geneva along the River Rhône is remarkable with its small, but notable, influence of submediterranean elements. The Chloropidae have not yet been studied in detail and the old collection of the Natural History Museum houses less than 100 specimens. The author, however, is collecting them regularly, and some excursions were devoted entirely to these flies. Therefore, several thousand specimens were collected since 1999, and many of them have been named in the meantime. So far, just 100 species are known from Geneva (Merz, in preparation), although specimens of some difficult genera are not yet identified (*Meromyza* spp. and most *Oscinella* spp. and *Chlorops* spp.). In addition, a small, but very interesting sample was collected on a window on a veranda in a garden. The study of this material led to the discovery of at least two very distinctive, unmistakable species of the subfamily Oscinellinae which are new to science. This unexpected result shows that the biological diversity of this small canton is remarkably high although many formerly rich areas were destroyed by human activities. Despite the comparatively good knowledge of the family in Central

Europe there are still some unexpected species to be discovered, and there is an urgent need to investigate the potentially rich areas carefully.

This paper presents these two species new to science with detailed descriptions and illustrations and compares them with morphologically related species. One of them is currently only known from the canton Geneva, the other species from one locality in Geneva and from a second locality in southern Switzerland. A key to the Western Palaearctic species of the two genera concerned is provided which should allow easy recognition.

MATERIAL AND METHODS

The material studied is deposited in the entomological collection of the Natural History Museum Geneva (= Muséum d'histoire naturelle Genève, MHNG). The specimens were either swept from vegetation with an insect net (diameter 40 cm) or they were collected at the window of a terrace in a garden which was treated with a contact insecticide. For the new species the locality data is cited verbatim and arranged alphabetically. Morphological terms in the descriptions follow Merz & Haenni (2000) except the antennae for which the interpretation of Stuckenberg (1999) is adopted.

SYSTEMATIC PART

Siphunculina Rondani, 1856: 128.

TYPE SPECIES: *Siphunculina brevinervis* Rondani, 1856 (= *Siphonella aenea* Macquart, 1835) (original designation).

In this genus 33 species have been described so far. Most of them are known in the Oriental Region (Kanmyia, 1983, 1989, 1994). Only eight species occur in the Palaearctic Region, six of which have been recorded in the Western Palaearctic Region (Nartshuk, 2005, 2007). Little is known about their biology. According to Ferrar (1987) and Ismay & Nartshuk (2000) the larvae may be found in birds' nests (*S. nidicola*), in excrement (*S. aenea*, *S. ornatifrons*, *S. striolata*) or in dead animals. Kanmyia (1983) wrote: "The larvae may be scavengers or scatophagous.". One species of the Oriental Region, *S. funicola* (de Meijere), is a vector of eye disease and therefore of medical importance.

Siphunculina ismayi sp. n.

Figs 1-9 and Plate A1-4

MATERIAL STUDIED: Holotype ♂: "Helv., GR, 330 m, Grono (Moesa), 31.VIII.2006 / 5, leg. B. Merz" (MHNG). – Paratypes: 1 ♀, "CH: GE, Corsier-Port, Vitre véranda, 1.-31.VI.2006, C. Besuchet" (MHNG) – 7 ♀, same data as before, but 1.-31.VII.2006 (MHNG). – 2 ♂, 3 ♀, same data as holotype (MHNG). – 1 ♂, "Helv., GR, 350 m, Grono (Dorf), 31.VIII.2006 /4, leg. B. Merz" (MHNG). The holotype is double mounted and pinned on a minutien pin on a block of plastrozote. It is in excellent condition.

ETYMOLOGY: The species is named in honour of John W. and Barbara Ismay, specialists of the family Chloropidae.

DIAGNOSIS: Typical species of *Siphunculina* Rondani with its short vein R2+3 reaching the Costa about at level of DM-Cu crossvein (Fig. 4) and with the face anteroventrally slightly projecting anteriorly to the eye (Fig. 1). It differs from its

congeners in the Palaearctic Region by the following combination of characters: Ocellar triangle not reaching anterior margin of frons (Fig. 2), the latter uniformly matt grey microtrichose, leaving only three small shining black spots laterally and anteriorly of ocelli; mesonotum and scutellum (Fig. 3, Plate A4) densely dull grey microtrichose, covered with whitish, stubby, lanceolate setulae. Male terminalia in lateral view with the surstylus pointed apically (Fig. 5).

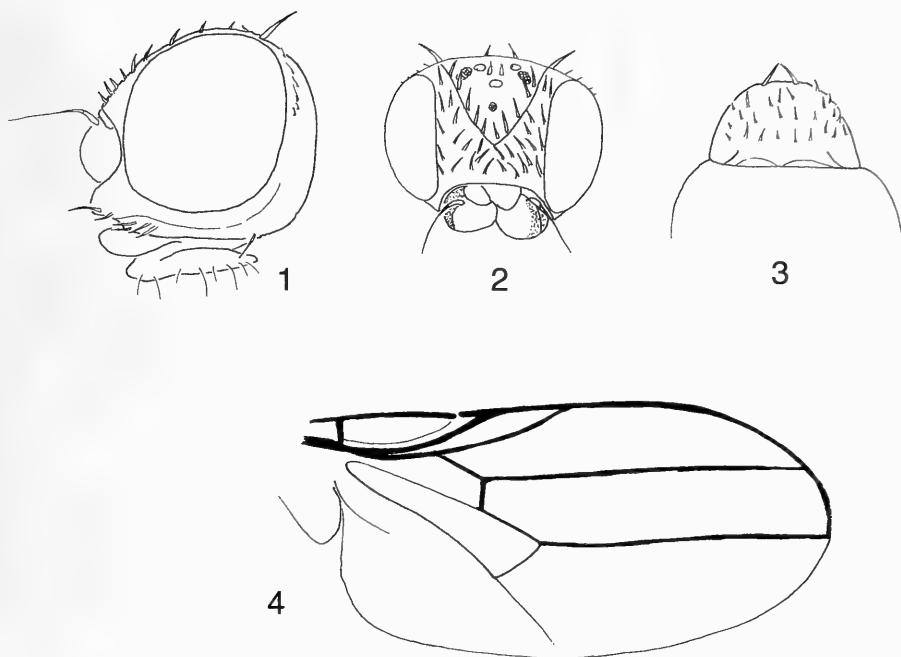
DESCRIPTION

Wing length: Male (n=4) 1.0-1.4 mm (holotype 1.02 mm); female (n=3) 1.25-1.35 mm.

Colouration: Head dull black, densely grey microtrichose, but ventral half of gena above oral cavity, ventralmost part of occiput and labellae shining; ocellar triangle grey microtrichose with 3 small shining black spots laterally of ocelli and just anterior of anterior ocellus; palpus, dorsalmost part of facial keel, pedicellus, ventral half of postpedicel and base of arista yellow brown. Thorax black, mesonotum, scutellum and dorsal half of pleura microtrichose, dull; ventral half of pleura shining. Legs black, but anterior trochanter, all knees, apical quarter of tibiae and tarsi yellow brown. Halter with yellow brown stem and black knob. Abdomen black, tergites thinly microtrichose, subshining.

Head (Figs 1-2, plate A1-3): In profile about as long as high; gena less than one quarter as high as eye, distinctly narrower than width of postpedicel; vibrissal angle projecting anterior to eye; compound eye almost spherical, only little higher than long, bare; frons almost square, about twice as wide as one eye, eye margins parallel; ocellar triangle about three quarters as long as frons, apex not sharply separated from interfrontal plate; lunule rather horizontal; face with deep antennal grooves and a high facial keel which is wide dorsally and contracted in middle; antenna with minute scape and small pedicel; postpedicel about one fifth higher than long, roundish, conspicuous, covered with short, white setulae; arista very shortly pubescent, about one quarter longer than antenna; mouthparts not projecting, palpus and labellae reaching anterior margin of oral cavity; labellae geniculate. Chaetotaxy: all setae and setulae white, lanceolate, rather thick and stubby; frons with a row of 4-6 reclinate fronto-orbital setae and numerous inclinate setae on interfrontal plate; slightly inside margin of ocellar triangle with about 6 conspicuous inclinate setae; ocellar seta shorter than fronto-orbital setae, upright; postocellar seta inclinate; lateral vertical seta eclinate; vibrissa distinct but short.

Thorax (Fig. 3, plate A4): Mesonotum covered with numerous conspicuous white, lanceolate, stubby, thick setulae which are arranged in 6-10 irregular and poorly delimited rows; postpronotum and dorsum of scutellum with similar white, thick, lanceolate setulae; notopleuron more or less bare; scutellum about two thirds as long as wide at base; pleura black shining, but posterodorsal half of anepisternum, anepimeron, anatergite, katatergite, meron and medial part of katepisternum dull, microtrichose; anepisternum bare; postscutellum shining. Chaetotaxy: setae lanceolate, white, thick, only little longer than setulae; no distinct postpronotal seta; 1+1 notopleural setae (in one specimen 2 anterior notopleural setae); 1 dorsocentral seta close to scutellum; 1 supra-alar seta; 1 (pair of) apical scutellar seta inserted on small tubercle, shorter than



FIGS 1-4

Siphunculina ismayi sp. n. male holotype. (1) Head, lateral view. (2) Head, dorsal view. (3) Scutellum, dorsal view (drawn in situ). (4) Wing (drawn in situ).

half the length of the scutellum, separated from each other by the length of one seta; basal scutellar seta not developed.

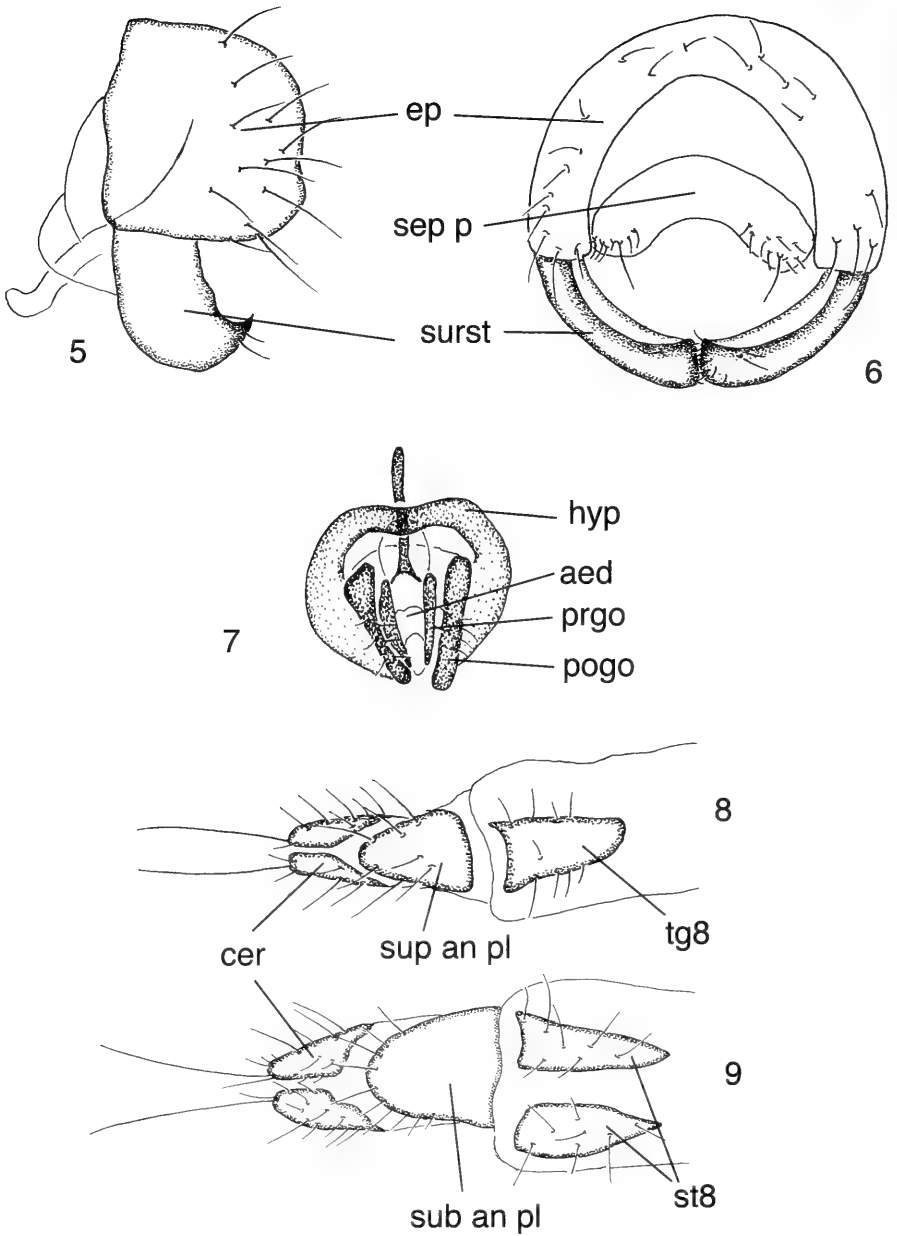
Legs: Almost bare, setulae short, yellow whitish, thin; hind tibia in both sexes posteriorly along the length of the black ring in middle with a narrow, elongated tibial organ.

Wing: Shape as Fig. 4 and Plate A1; hyaline; veins yellow; anal lobe well developed; length and shape of veins as typical for the genus with the short R2+3 which is about as long as the distance between R4+5 and M1+2 along Costa; the latter reaching M1+2.

Abdomen: Oval to elongate depending on drying, almost bare, covered with short, thin, yellow whitish fine setulae which are slightly longer at posterior margin of tergites.

Male terminalia (Figs 5-7): Epandrium (Fig. 6) a semicircle, sparsely setulose; subepandrial plate with few setulae laterally; surstylus (Figs 5-6) shovel like, in caudal view strongly converging, in lateral view pointed at apex, almost bare except for apex; hypandrium (Fig. 7) open distally, forming a bridge basally, bare; postgonite with few setulae; pregonite bare, forming a sheath around the aedeagus; the latter soft.

Female terminalia (Figs 8-9): Ovipositor soft, retractable in preabdomen; tergite 8 an unpaired sclerite, sparsely setulose; sternite 8 paired, sparsely setulose; supra-anal plate triangular, pointed apically; border of subanal plate evenly setulose, setulae arranged in one row; cerci with a long apical seta.



FIGS 5-9

Siphunculina ismayi sp. n. (5) Epandrium and surstylus, lateral view (male paratype). (6) Epandrium, subepandrial plate and surstylus, caudal view (male paratype). (7) Phallic complex, ventral view (male paratype). (8) Apex of ovipositor, dorsal view (female paratype). (9) Same, ventral view (female paratype). Abbreviations: aed = aedeagus; cer = cerci; ep = epandrium; hyp = hypandrium; pogo = postgonite; prgo = pregonite; st8 = sternite 8; sep p = subepandrial plate; sub an pl = subanal plate; sup an pl = supra-anal plate; surst = surstylus; tg 8 = tergite 8.

A2



A4



A1



A3



PLATE A

Siphunculina ismayi sp. n. male paratype. (1) Habitus, lateral view. (2) Head, frontal view. (3) Head, dorsal view. (4) Mesonotum and scutellum, dorsal view.

REMARKS: Currently, three species of *Siphunculina* are known from Northern and Central Europe which differ clearly in the characters given in the key (see below) and the diagnosis. The new species is very peculiar with the presence of the white, stubby, lanceolate setulae on the grey microtrichose mesonotum and scutellum in combination with the short, mainly grey microtrichose ocellar triangle and may belong to a group of Oriental species with the same type of setulae on head and thorax. It differs from *S. nidicola* Nartshuk and *S. aenea* (Macquart) in the structure of the male terminalia (Andersson, 1977; Nartshuk, 1971; Kanmyia, 1983).

BIOLOGY: The specimens from Corsier were collected dead on the window sill of a garden place which was treated partly with insecticides. On the other hand, the whereabouts of the finding of the specimens from Grono cannot be reconstructed. They were probably swept from vegetation underneath some trees. Both localities are characterized by a warm, sunny climate.

DISTRIBUTION: So far only known from two localities in Switzerland, one south of the Alps (Grono) and one north of the Alps, in the canton Geneva.

SHORT KEY TO WESTERN PALAEARCTIC SPECIES OF *SIPHUNCULINA* RONDANI:

- 1a Ocellar triangle not reaching anterior margin of frons 2
- 1b Ocellar triangle reaching anterior margin of frons 3
- 2a Ocellar triangle mostly matt, microtrichose *Siphunculina ismayi* sp. n.
- 2b Ocellar triangle shining black (Eastern part of Central Europe to Mongolia) *Siphunculina nidicola* Nartshuk, 1971
- 3a Mesonotum entirely shining black 4
- 3b Mesonotum dull black, microtrichose, or only setulae on small shining black spots 5
- 4a Fronto-orbital plates uniformly black shining; gena narrow, as in *S. ismayi* (Fig. 1) (Palaeartic Region) *Siphunculina aenea* (Macquart, 1835)
- 4b Fronto-orbital plates between the fronto-orbital setae with grey-microtrichose spots; gena much wider, almost as wide as diameter of post-pedicel (South Europe, North Africa, Afrotropical and Oriental Regions) *Siphunculina ornatifrons* (Loew, 1858)
- 5a Frons and mesonotum uniformly black (Western Palaeartic Region) *Siphunculina quinquangula* (Loew, 1873)
- 5b Frons and mesonotum with setae and setulae inserted on dusted spots (Madeira, Asia, Afrotropical and Oriental Regions) *Siphunculina striolata* (Wiedemann, 1830)

FURTHER MATERIAL STUDIED

Siphunculina aenea (Macquart, 1835)

MATERIAL STUDIED: 1 ♀, CH: GE, Chancy, bord du Rhône, 350 m, 28.VII.2002, leg. B. Merz (MHNG). – 7 ♂, 15 ♀, GE, Corsier-Port, vitre véranda, VI.2003-VII.2006, leg. C. Besuchet (MHNG). – 1 ♀, GL, Schwanden, 600 m, 20.VI.1993, Merz & Eggenberger (MHNG). – 1 ♀, ZH, Zürich-Waldgarten, 450 m, 27.VII.1996, leg. B. Merz (MHNG). – 1 ♀, ZH, Zürich-Zürichberg, 600 m, 17.IX.1992, leg. B. Merz (MHNG).

Siphunculina ornatifrons (Loew, 1858)

MATERIAL STUDIED: 1 ♀, ISRAEL: Antipatris, 8.VI.1996, leg. B. Merz (MHNG). – 1 ♂, 1 ♀, Herzliyya, 8.VI.1996, Merz & Freidberg (MHNG).

Speccafrons Sabrosky, 1980: 424.

TYPE SPECIES: *Oscinella mallochi* Sabrosky, 1938 (original designation).

This small genus was proposed rather recently by Sabrosky (1980) for a Nearctic species which was placed in *Oscinella* but differs in the structure of the male terminalia with the expanded surstylus, the speckled frons and the development of numerous soft setulae on the scutellum. Currently, five species are placed in *Speccafrons*, three of which are known in the Palaearctic Region. Two species were described from the Western Palaearctic Region (Nartshuk, 2007). The larvae of all species with known biology were reared from egg masses of spiders where they are apparently carnivorous (Ismay & Nartshuk, 2000).

Speccafrons genavensis sp. n.

Figs 10-20 and Plate B1-4

MATERIAL STUDIED: Holotype ♂: "Helv., GE, 510 m, Bernex-Signal, 20.VI.2008, leg. B. Merz" (MHNG). – Paratypes: 1 ♀, "CH: GE, Corsier-Port, vitre véranda, 27.-29.VI.2003, C. Besuchet" (MHNG). – 1 ♀, same data as before, but 16.-31.VIII.2003 (MHNG). – 2 ♀, same data as before, but 1.-31.VI.2004 (MHNG). – 2 ♀, same data as before, but 1.-31.VII.2005 (MHNG). – 2 ♀, same data, but 1.-31.VII.2006 (MHNG). The holotype is double mounted and pinned on a minuten pin on a block of plastozote. It is in excellent condition. The abdomen was removed and it is stored in glycerol in a glass vial attached to the main pin.

ETYMOLOGY: The species is named after the type locality.

DIAGNOSIS: Fitting the concept of the genus as described by Sabrosky (1980) with the speckled frons, setulose compound eye, the mesonotum densely setulose but the setulae not arranged in lines, the numerous long setulae along the margin of the scutellum and the large, globose surstylus. It differs from other Western Palaearctic species of the genus by the bicoloured gena (dorsal half orange, ventral half blackish), the shining dorsum of the mesonotum and the fore coxa which have at least a large black stripe (male) or are almost entirely black (female).

DESCRIPTION

Wing length: Male (n=1) 1.87 mm (holotype); female (n=8) 1.63-1.95 mm.

Colouration: Head matt, bicoloured: frons yellow brown to brown, grey microtrichose, but setae and setulae inserted on tiny shining spots giving it a speckled appearance; slightly paler just dorsally of lunule; ocellar triangle shining black, but to different degree silvery microtrichose (in male thinly microtrichose only on three small areas around ocelli; female stronger microtrichose, in one specimen only anterior of anterior ocellus with a shining spot); face brown to black, slightly darker on keel; occiput black; gena in dorsal half orange, in ventral half dark brown to black; antenna yellow but anterodorsal half of postpedicel blackish; arista orange at base, flagellum darker; clypeus black, partly grey microtrichose; palpus yellow, labellae darker. Thorax black, strongly shining on dorsal surface of mesonotum and most parts of pleura; thinly grey microtrichose laterally of presutural seta, a stripe on mesonotum just anterior scu-

tellum, on scutellum, on posterodorsal half of anepisternum and anterodorsal half of anepimeron; prosternum mostly yellow to brown. Legs mostly black, dull, but all knees, tip of all tibiae and all tarsi brown; fore coxa in male mostly brown, in female mostly black. Halter yellow. Abdomen black, tergites mostly grey microtrichose, only sides to various degrees shining.

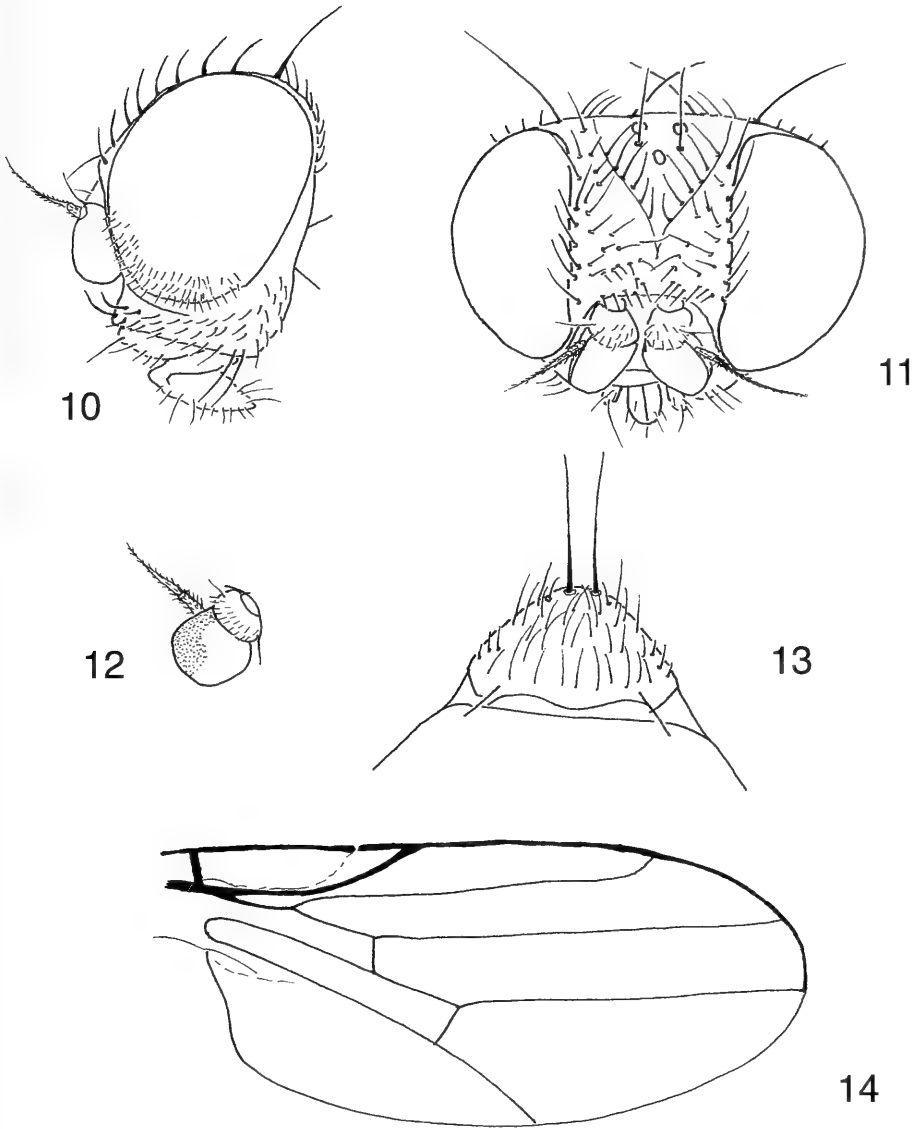
Head (Figs 10-12, plate B1-3): In profile about 1.25 times as high as long; gena about one sixth as high as compound eye, about two thirds as wide as postpedicel and at least 1.5 times as wide as diameter of fore tibia; vibrissal angle not projecting anteriorly to eye; compound eye 1.2 times as high as wide, densely covered with pale, conspicuous setulae; frons almost square, about one third wider than compound eye, covered with numerous inclinate, black, thin, acuminate setulae; ocellar triangle about two thirds as long as frons, sharply pointed apically; face strongly concave, dorsally with distinct keel between antennal bases, fading ventrally; occiput and posterior part of head almost straight; antenna (Fig. 12) with small scape and pedicel, the latter setulose; postpedicel spherical, about as long as wide, indistinctly pointed dorso-apically; arista short, covered with short, but distinct setulae; mouthparts not projecting, palpus and labellae reaching anterior margin of oral cavity; labellae short spatulate. Chaetotaxy: all setae and setulae dark brown to black, thin, acuminate; 6-8 reclinate fronto-orbital setae in one line; 1 upright ocellar seta; ocellar triangle along border with a row of about 6 conspicuous setae; 1 inclinate postocellar seta; 1 eclinate, long lateral vertical seta; medial vertical seta not differentiated; a row of tiny postocular setae; gena with 1-3 stronger vibrissal setae and about 3 irregular rows of genal setae in ventral half; dorsal half of gena bare.

Thorax (Fig. 13, plate B4): Robust, mesonotum about as wide as long, densely covered with conspicuous, fine, whitish, acuminate setulae which are not arranged in rows; setulae on postpronotum slightly thicker, black; notopleuron without setulae; scutellum semicircular, about two thirds as long as wide at base, on disc with long, whitish, thin setulae, and with black setulae along margin; pleura bare except for some setulae on posterodorsal half of katepisternum; postscutellum shining. Chaetotaxy: all setae dark brown to black, usually longer and thicker than surrounding setulae; 1 postpronotal seta; 1+2 notopleural setae; 1 dorsocentral seta close to scutellum; 1 supra-alar seta; 1 much shorter postalar seta; 1 (pair of) parallel-sided apical scutellar seta which is not inserted on a tubercle and which is distinctly longer than length of scutellum; basal scutellar seta not differentiated; 1 weak, upright, short proepimeral seta just dorsally of fore coxa.

Legs: Densely covered with pale setulae; fore femur thicker than other femora; hind tibia slightly banana-shaped, curved, posteriorly with a distinct oval tibial organ.

Wing: Shape as in Fig. 14, plates B1 and B4; hyaline; veins yellow, all conspicuous and rather thick; anal lobe well developed; venation as typical for the genus; veins more or less parallel-sided, only R2+3 upturned to Costa at tip; Costa reaching M1+2; section between R1 and R2+3 1.5 to twice as long as section between R2+3 and R4+5; cross-vein R-M about at level of tip of R1.

Abdomen: Compact, somewhat oval; tergites covered with numerous soft, short, light brownish setulae which are distinctly shorter than length of corresponding tergite.



FIGS 10-14

Speccafrons genavensis sp. n. male holotype. (10) Head, lateral view. (11) Head, dorsal view; (12) Antenna in maximal extension (drawn in situ). (13) Scutellum, dorsal view (drawn in situ). (14) Wing (drawn in situ).

Male terminalia (Figs 15-18): Sternite 4 oval, setulose; sternite 5 shorter than sternite 4, wider at base, apically distinctly concave, setulose on basal two thirds, setulae inserted on stronger sclerotization (Fig. 15); epandrium in caudal view a semicircle, setulose (Fig. 17); in dorsal view divided into two symmetrical sclerites which are



PLATE B

Speccafrons genavensis sp. n. male holotype. (1) Habitus, lateral view. (2) Head, frontal view; (3) Head, dorsal view. (4) Mesonotum and scutellum, dorsal view.

united over a narrow, darker, stronger sclerotized bridge; subepandrial plate like a pair of very narrowly connected glasses, apically with some setulae; surstylus very large, globose, elongate oval in caudal view, with a medial tooth, only sparsely setulose (Figs 16-17) medially, weakly articulating with epandrium; hypandrium (Fig. 18) closed posteriorly by a narrow bridge; anteriorly with a large, wide bridge; postgonite rounded apically, with two setulae and two pits; phallapodeme reaching base of hypandrium, posteriorly forming an open circle in which the aedeagus is embedded; aedeagus a small, sclerotized tube.

Female terminalia (Figs 19-20): Ovipositor retractable, when fully extended longer than preabdomen; tergite 8 a single sclerotized plate, with two setulae; sternite 8 divided into two sclerotized plates which are pointed apically and sparsely setulose; supra-anal plate rounded distally, sparsely setulose on surface; subanal plate similar; cerci close together, distally truncate, setulose along margin.

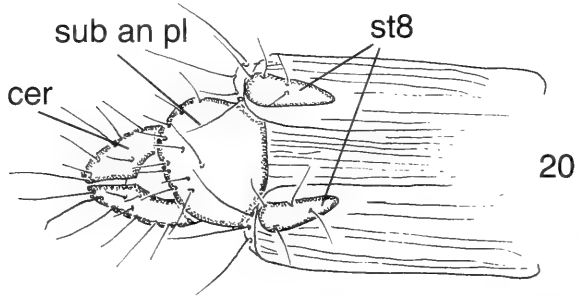
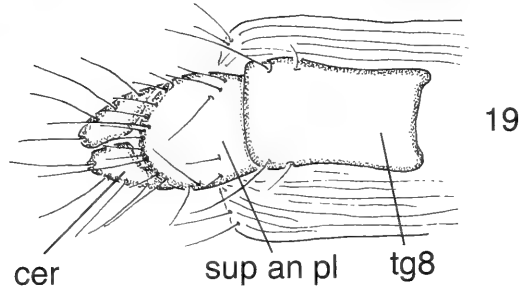
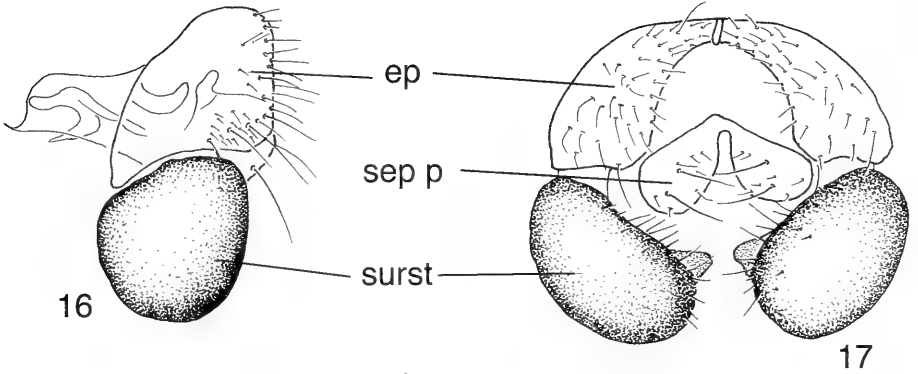
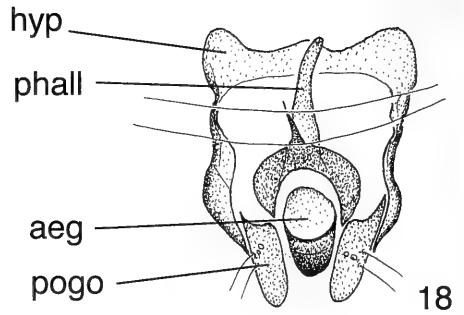
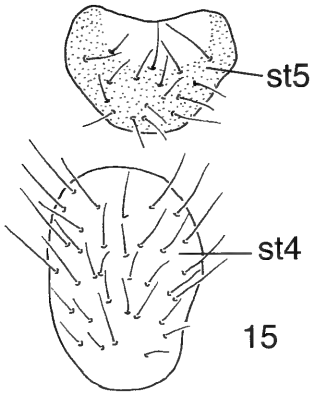
REMARKS: The new species resembles externally *S. cypria* in most characters. Differences are provided in the key (below), in details of male terminalia and in their distribution. The other European species, *S. halophila*, is morphologically very different (especially with a microtrichose, matt mesonotum, see Duda, 1933), and the surstylus is less expanded than in the new species (compare Fig. 7 in Nartshuk, 1990, with Fig. 17).

BIOLOGY: The holotype was swept in a public park next to the highest point of the canton Geneva under some trees which are forming an open forest. The other specimens from Corsier were collected at the same place as those of *Siphunculina ismayi* sp. n.

DISTRIBUTION: Only known from two localities in the canton Geneva (Switzerland).

KEY TO WESTERN PALAEARCTIC SPECIES OF *SPECCAFRONS* SABROSKY:

- 1a Mesonotum matt, black, thinly grey microtrichose, but setae and setulae on shining, small spots (gena over 1.5 times as wide as diameter of fore tibia) *Speccafrons halophila* (Duda, 1933)
- 1b Mesonotum shining black dorsally, but thinly grey microtrichose laterally of presutural seta and along its posterior margin; width of gena variable 2
- 2a Darker species: anterior coxa in male yellow with a black stripe on inner side (male) or almost entirely black (female); all setae on head and thorax dark brown to black; gena bicoloured with yellow dorsal half and dark brown ventral half, over 1.5 times as wide as diameter of fore tibia *Speccafrons genavensis* sp. n.
- 2b Paler species: fore coxa yellow to pale brown, with indistinct infuscation on inner side in male or entirely yellow (female); setae on head and thorax yellow to yellow brown; gena uniformly yellow; gena about as wide as diameter of fore tibia *Speccafrons cypria* Nartshuk, 1990



FURTHER MATERIAL STUDIED

Speccafrons cypria Nartshuk, 1990

MATERIAL STUDIED: 1 ♂, CYPRUS: Lemasos, Pegasus beach hotel, 34.42N/33.06E, garden, beach, 0 m, 29.IV.2002, St. 29, leg. Merz, Deeming, Ebejer & Gatt (MHNG). – 1 ♀, ISRAEL: Panyas, 29.V.2000, leg. B. Merz (MHNG).

Speccafrons halophila (Duda, 1933)

MATERIAL STUDIED: 1 ♂, CH: GE, Chancy, bord du Rhône, 350 m, 28.VII.2002, leg. B. Merz (MHNG). – 2 ♀, VS, Morgins, La Chaux-Culet, 1700-1900 m, 21.VI.2003, leg. B. Merz (MHNG).

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REFERENCES

- ANDERSSON, H. 1977. Taxonomic and phylogenetic studies on Chloropidae (Diptera) with special reference to Old World genera. *Entomologica Scandinavica, Supplementum* 8: 1-200.
- DELY-DRASKOVITS, A. 1998. 95. Chloropidae (pp. 306-310). In: MERZ, B., BÄCHLI, G., HAENNI, J.-P. & GONSETH, Y. (eds). Diptera - Checklist. *Fauna Helvetica* 1: 1-369.
- DELY-DRASKOVITS, A., BÄCHLI, G. & MERZ, B. 1993. Zur Fauna der Chloropidae (Diptera) der Schweiz. *Mitteilungen der Entomologischen Gesellschaft Basel* 43: 69-84.
- DUDA, O. 1932-1933. 61. Chloropidae. In: LINDNER, E. (ed.). Die Fliegen der Palaearktischen Region. Volume 6(1). *E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart*, 248 pp. & 3 plates.
- FERRAR, P. 1987. A Guide to the Breeding Habits and Immature Stages of Diptera Cyclorrhapha. *Entomonograph* 8, Part 1: text: 1-478.
- GREPPIN, H., DEGLI AGOSTI, R. & PRICEPUTU, A. M. 2007. Environnement et développement durable en Suisse: confédération, cantons et zones métropolitaines. *Archives des Sciences* 60(1): 13-32.
- ISMAY, J. W. & NARTSHUK, E. P. 2000. A. 11. Family Chloropidae (pp. 387-429). In: PAPP, L. & DARVAS, B. (eds). Contributions to a Manual of Palaearctic Diptera. Appendix Volume. *Science Herald, Budapest*, 604 pp.

FIGS 15-20

Speccafrons genavensis sp. n. (15) Sternites 4 and 5 (male holotype). (16) Epandrium and surstylus, lateral view (male holotype). (17) Epandrium, subepandrial plate and surstylus, caudal view (male holotype). (18) Phallic complex, ventral view (male holotype). (19) Apex of ovipositor, dorsal view (female paratype). (20) Same, ventral view (female paratype). Abbreviations: aed = aedeagus; cer = cerci; ep = epandrium; hyp = hypandrium; phall = phall-apodeme; pogo = postgonite; st8 = sternite 8; sep p = subepandrial plate; sub an pl = subanal plate; sup an pl = supra-anal plate; surst = surstylus; tg 8 = tergite 8.

- KANMYIA, K. 1983. A Systematic Study of the Japanese Chloropidae (Diptera). *Memoirs of the Entomological Society of Washington* 11: 1-370.
- KANMYIA, K. 1989. Study on the eye-flies, *Siphunculina* Rondani from the Oriental Region and Far East (Diptera, Chloropidae). *Japanese Journal of Sanitary Zoology* 40 (Supplement): 65-86.
- KANMYIA, K. 1994. Studies on the eye-flies *Siphunculina* Rondani from Nepal (Diptera: Chloropidae). *Japanese Journal of Sanitary Zoology* 45 (Supplement): 55-69.
- MERZ, B. & HAENNI, J.-P. 2000. 1.1. Morphology and terminology of adult Diptera (other than terminalia) (pp. 21-51). In: PAPP, L. & DARVAS, B. (eds). Contributions to a Manual of Palaearctic Diptera. Volume 1. *Science Herald, Budapest*, 978 pp.
- MERZ, B., BÄCHLI, G. & HAENNI, J.-P. 2002. Erster Nachtrag zur Checkliste der Diptera der Schweiz. *Mitteilungen der Entomologischen Gesellschaft Basel* 51(3-4) (2001): 110-140.
- MERZ, B., BÄCHLI, G. & HAENNI, J.-P. 2007. Zweiter Nachtrag zur Checkliste der Diptera der Schweiz. *Mitteilungen der Entomologischen Gesellschaft Basel* 56 (4) (2006): 135-165.
- MERZ, B., BÄCHLI, G., HAENNI, J.-P. & GONSETH, Y. (eds). 1998. Diptera, Checklist. *Fauna Helvetica* 1: 1-369.
- MERZ, B., ISMAY, J. W., SCHULTEN, B. & DELY-DRASKOVITS, A. 2005. Neue und selten gesammelte Chloropidae (Diptera) der Schweiz. *Mitteilungen der Entomologischen Gesellschaft Basel* 55(3): 74-87.
- NARTSHUK, E. P. 1971. Ergebnisse der zoologischen Forschungen von Dr. Z. Kaszab in der Mongolei. 252. Chloropidae, Part 1. Oscinellinae (Diptera). *Annales Historico-Naturalis Musei Nationalis Hungarici, Pars Zoologica* 63: 275-299.
- NARTSHUK, E. P. 1990. Chloropid flies (Diptera, Chloropidae) of Cyprus. *Entomologica Fennica* 1: 227-232.
- NARTSHUK, E. P. 2005. Grassflies (Diptera, Chloropidae) of South Korea, with a Review of Species of the Genus *Centorisoma* Becker. *Entomological Review* 85(5): 555-568.
- NARTSHUK, E. P. 2007. Fauna Europaea: Chloropidae. In: PAPE, T. (ed.). Fauna Europaea: Diptera, Brachycera. Version 1.3. <http://www.faunaeur.org> (accessed 8 August 2008).
- SABROSKY, C. W. 1980. New genera and new combinations in Nearctic Chloropidae (Diptera). *Proceedings of the entomological Society of Washington* 82(3): 412-429.
- STUCKENBERG, B. R. 1999. Antennal evolution in the Brachycera (Diptera), with a reassessment of terminology relating to the flagellum. *Studia Dipterologica* 6(1): 33-48.

The European athecate hydroids and their medusae (Hydrozoa, Cnidaria): Filifera Part 4

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The European athecate hydroids and their medusae (Hydrozoa, Cnidaria): Filifera Part 4. - This study reviews all European hydroids belonging to the filiferan family Eudendriidae. Two new species occurring in the northeastern Atlantic are described: *Eudendrium capillaroides* new spec. and *Eudendrium unispirum* new spec. *Eudendrium vaginatum* Allman, 1863, is redescribed. It is characterized by a special type of nematocysts and traits of the perisarc. It is distinct from *Eudendrium annulatum* Norman, 1864, which is a separate, valid species. *Eudendrium fragile* Motz-Kossowska, 1905 and *Eudendrium islandicum* Schuchert, 2000 are both recognized as synonyms of *E. album* Nutting, 1898. *Eudendrium stratum* Bonnevie, 1898 and *E. planum* Bonnevie, 1898 are both recognized as synonyms of *E. rameum* (Pallas, 1766). *Eudendrium insigne* Hincks, 1861 is indistinguishable from *E. ramosum* and newly collected material from the type locality confirmed this. *Eudendrium insigne* must thus be regarded as a synonym of *E. ramosum* (Linnaeus, 1758). A re-examination of the type material of *Eudendrium elsaeoswaldae* Stechow, 1921 revealed that it is conspecific with *E. ramosum* (Linnaeus, 1758), becoming thus a new synonym of the latter.

Perigonimus multicornis Allman, 1876 is indistinguishable from *Myrionema hargitti* (Congdon, 1906) and must be regarded as a senior synonym of the latter. Because it seems likely that the original type locality designation “Kattegat” was incorrect, it should not replace *M. hargitti* or *M. amboinense*.

Keywords: Cnidaria - marine - Hydrozoa – Eudendriidae - revision - taxonomy - north-eastern Atlantic - Mediterranean.

INTRODUCTION

This study is the fifth in a series of taxonomic revisions and reviews of the European Anthoathecata (=Anthomedusae, Athecata). The previous ones are: Schuchert (2004; Oceaniidae and Pachycordylidae), Schuchert (2006; Acaulidae, Boreohydridae, Candelabridae, Cladocorynidae, Cladonematidae, Margelopsidae, Pennariidae, Protohydridae, Tricyclusidae), Schuchert (2007; Bougainvilliidae, Cytaeididae, Rathkeidae, and Pandeidae), Schuchert (2008; Hydractiniidae, Rhysiidae, Stylasteridae). The current paper treats one family only, namely the Eudendriidae. Many of the European Eudendriidae have recently been studied by Marques *et al.*

(2000a, 2000b), but an update and more complete species descriptions, including also all species of the northeastern Atlantic, was needed. Although the members of the genus *Eudendrium* are rather unique and it is easy to identify a hydroid as belonging to this genus (Fig. 1), the identification at the species level is sometimes rather difficult. As outlined by Marques *et al.* (2000b), the state of the *Eudendrium* species was confused until the middle of the last century, with many species being unrecognizable. The application of nematocyst data improved the situation considerably and nowadays species identification relies predominantly on the cnidome. This change in taxonomic practice made most previous species records untrustworthy. Other morphological characters are still important, though, especially in those species that have the same type of capsules (e. g. *E. ramosum*, *E. rameum*, *E. merulum* etc.). It seems, however, that the species diversity has been underestimated.

Concomitantly with this study, also a comparison of the 16S gene DNA sequence was begun, using besides the species and populations mentioned here many more from various places all over the world. Preliminary results of this study, which will be published elsewhere, indicate that several morphospecies of *Eudendrium* are actually composed of more than one lineage and thus likely belong to different species. Moura *et al.* (2008) arrived at a similar conclusion.

MATERIAL AND METHODS

See also Schuchert (2008). Where possible, it was attempted to supplement the species descriptions by sequence information of part of the 16S mitochondrial rRNA gene. The methods to obtain DNA sequences are described in Schuchert (2005, 2007). All sequences have been submitted to the EMBL database (accession numbers **AM991292-AM991307**). The origin and identity of the material used to obtain the 16S sequence data as well as the accession numbers are given for each species in the section "Material examined". 16S sequences of some non-European Eudendriidae were also determined, namely *Myrionema amboinense* (MHNG INVE60162, aquarium culture of unknown origin, **AM991292**), *Eudendrium maorianus* (MHNG INVE29972, New Zealand, **AM991303**), *E. ritchiei* (MHNG INVE29971, New Zealand, **AM991304**). All available sequences, including also those published by Moura *et al.* (2008), were used to visualize the relatedness by a Maximum Likelihood analysis of HKY distances using the program PHYML described by Guindon & Gascuel (2003). A bootstrap analysis using 100 pseudoreplicates was made.

ABBREVIATIONS

BELUM	Ulster Museum, Belfast, Northern Ireland
BMNH	The Natural History Museum, London, England
ERMS	European Register of Marine Species (Costello <i>et al.</i> , 2001)
MHNG	Muséum d'histoire naturelle de Genève, Switzerland
ICZN	International Code of Zoological Nomenclature
IRSN	Institut Royal des Sciences Naturelles de Belgique, Bruxelles
SMNH	Swedish Museum of Natural History, Stockholm, Sweden
ZMO	Zoological Museum of Oslo, Norway
ZMUC	Zoological Museum Copenhagen, Denmark
ZSM	Zoologische Staatssammlung, Munich, Germany
r	ratio of nematocyst capsule length and width
s	ratio of shaft and capsule length in discharged capsules

GENERAL MORPHOLOGY AND IMPORTANT FEATURES

Eudendrium colonies are anchored to the substratum by tubular stolons. The stem of the colony may be branched or unbranched (=stolonial), either monosiphonic or polysiphonic (=fascicled, composed of several tubes). The stems and pedicels are always covered with firm perisarc which becomes abruptly very thin and filmy below the hydranths. The perisarc of the thicker tubules is usually smooth or wrinkled with characteristic groups of annulations at the origin of branches and sometimes also elsewhere.

The hydranths are relatively large for colonial marine hydroids and distinguished from all other families of the athecate hydroids by a wide, trumpet-shaped or spherical hypostome. The tentacles are filiform, their nematocysts often in transverse linear arrays, the density decreasing towards proximal. The nematocysts can be either oriented parallel to the tentacle resulting in rather smooth tentacles, or they can be inserted obliquely giving a spiny appearance (Puce *et al.*, 2005). On the hydranth body, there can be a band or buttons of nematocysts (Figs 1A; 3B). Rarely, there is also a tentacle-like protrusion near the base of the body, a nematophore (Fig. 1A). Near the base of the hydranth column, sometimes also in the middle, there is always a ring of specialized cells that secrete the perisarc in a fold of the epidermis. This basal groove is always present, but in some species or under some circumstances it can become rather inconspicuous or almost invisible.

Male and female gonophores are normally produced in separate colonies, but a few species are hermaphrodites (e. g. *E. simplex*). Reproduction is by fixed sporosacs which in many cases develop in a whorl round the base of the hydranth. The hydranth bearing the gonophores can be fully formed or reduced to various extents and is then called a blastostyle. The development of the gonophores starts concomitantly with the development of the budding of the new hydranth (blastostyle), even before the tentacles develop (Fig. 16C-E). In some species the hydranth grows to the same size as of a non-reproductive polyp, in others the hydranth development stops and often it gets atrophied again (e. g. Fig. 34E-G). There is considerable variation of this process between the species and to some extent it could also depend on the environment. In some species the gonophores/sporosacs form without a trace of a hydranth, the gonophores issuing in a tuft from the end of a pedicel. It is thus important to bear in mind that the blastostyles can change form and size during development, which makes it sometimes difficult in preserved material to decide whether they are actually reduced or only in an early stage of development, this in particular also for female gonophores after their fertilization.

The female gonophores consist normally of a spadix (Fig. 1B) arching over a single, large egg (exception *E. vervoorti*). The spadix may be simple or branched, which is an important taxonomic character. As the egg matures and then is fertilized in-situ, the spadix is resorbed, the fertilized egg develops a perisarc capsule and is attached to the pedicel below (Fig. 9E). The embryonic development to the planula larva takes thus typically place within the capsule and while still attached to the mother colony (comp. Mergner, 1957 and Fig. 9E). The dispersal capacity of the planula larva is rather modest (Sommer, 1992).

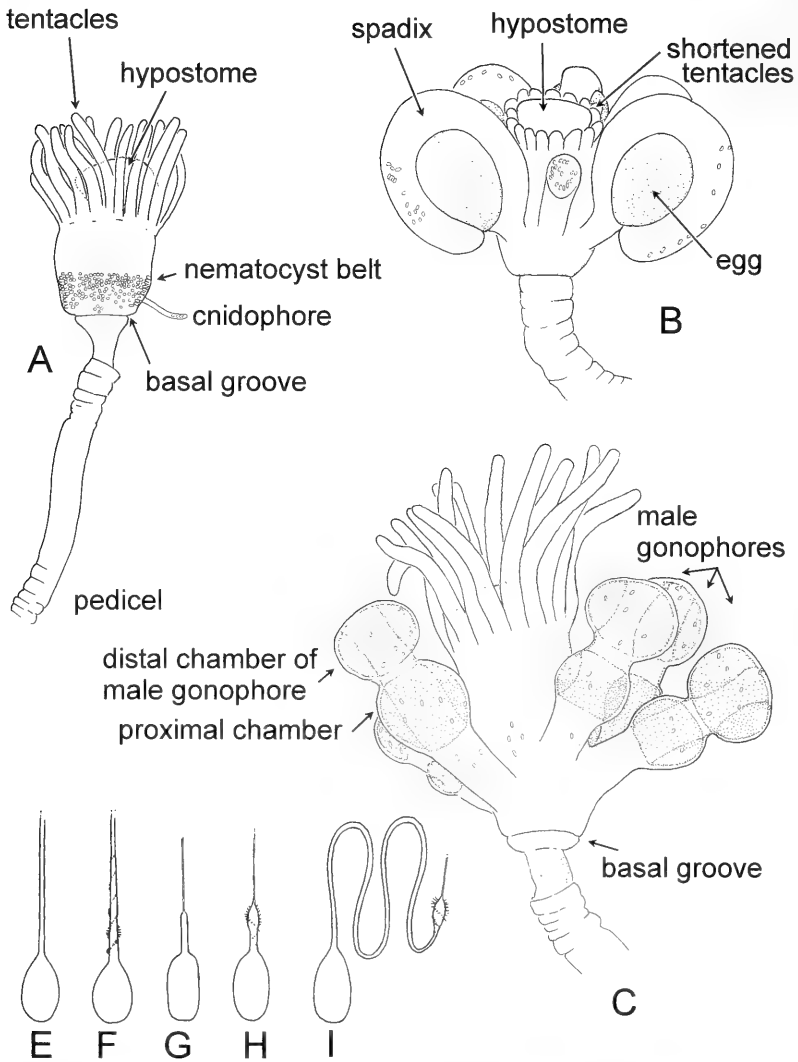


FIG. 1. Features and important terms of the Eudendriidae hydranths and gonozooids. (A) Hydranth and its pedicel. (B) Partially atrophied hydranth (blastostyle) bearing female gonophores. The gonophores are very simple, a large egg and a spadix that arches over it. In later stages after fertilization, the spadix is lost and the encapsulated embryos attach to the pedicels of the former blastostyle (Fig. 9D). (C) Hydranth with a whorl of male gonophores, each composed of two bulbous chambers. (E-H) Important nematocyst types found in the Eudendriidae, shown as discharged capsules. (E-F) Haploneemes, the everted tube has no thickened proximal part. (E) Isorhiza, the everted tubular part has a constant diameter. (F) Anisorhiza, the everted tubular part tapers constantly. (G-I) Heteroneme capsules, the everted tube is differentiated in to a thicker basal part, the shaft, which tapers abruptly into a thinner thread. (G) Microbasic mastigophores, the shaft is isodiametric and shorter than 2.5 capsule lengths. (H) Microbasic eurytele, the end of the shaft is swollen, the total length of the shaft is shorter than 2.5 capsule lengths. (I) Macrobasic eurytele, the shaft is more than 2.5 times as long as the capsule (=macrobasic), its end is swollen (=eurytele).

Male gonophores (Fig. 1C) typically consist of several bulbous chambers containing the spermatogenetic cells and arranged in linear series. In the earliest stages – in some species permanently – there is only one chamber, but as development proceeds additional chambers are added from below. Thus the number of chambers cannot be used as a diagnostic character although the maximal number may be characteristic for a species.

Crucial taxonomic characters are the types and sizes of the nematocysts (Fig. 1E-I). Also the absence of desmonemes from all species is notable. The Eudendriidae always possess small euryteles, present in large numbers on the tentacles and also in fewer numbers in the rest of the hydranth and coenosarc epidermis. This ubiquitous small type, also called the tentacular type, is taxonomically not important because it does not offer much interspecific variation. However, in most species there are one or more additional capsule types present which show considerable interspecific variation. These complementary nematocysts are less frequent but nevertheless abundant enough to be easily found. They never occur on the tentacles, but are confined to the hydranth body, hypostome, the coenosarc, and sometimes the gonophores. The complementary nematocysts are often – but not always – considerably larger than the tentacular type. The highest concentration is found on the hydranth body, sometimes in a broad horizontal band or in wart-like protrusions. The types of nematocysts relevant for the Eudendriidae are shown and explained in Fig. 1E-F. In order to observe discharged capsules, it is necessary to examine living material with a good compound microscope. One or two hydranths are placed in small drop of seawater on a microslide and then gently squeezed by covering them with a cover-glass. Occasionally, there are also some discharged capsules present in preserved material, which can be cleared by immersing in 50% lactic acid. Examination and measurement of nematocysts requires an oil-immersion objective that gives a final magnification of about 1000 times.

TAXONOMIC PART

FAMILY EUDENDRIIDAE L. AGASSIZ, 1862

SYNONYMS: *Eudendroidae* L. Agassiz, 1862: 342 [emended to Eudendriidae by Hincks, 1868]. – *Myrionemidae* Pictet, 1893.

DIAGNOSIS: Hydroid colony sometimes stolonial, but mostly with erect branched stem, arising from a creeping hydrorhiza; stem, branches and hydranth pedicels covered by perisarc, sometimes enveloping also lower half of hydranth in a cup-like process; hydranth large, urn-shaped with undercut hypostome, one or more whorls of solid filiform tentacles immediately below it, hydranth body sometimes with basal tentacle-like protrusion (nematophore); near base of hydranth an epidermal groove from which periderm is secreted, sometimes with a ring of nematocysts immediately above groove. Reproduction by fixed sporosacs borne on the hydranth body below the tentacles; reproductive hydranth can be partially reduced to a blastostyle or entirely reduced. Male gonophores usually with several bulbous chambers, successive chambers in linear series. Female gonophores sporosacs, initially with curved spadix supporting one large egg.

REMARKS: For a taxonomic history see Calder (1988) and Marques *et al.* (2000a). The family comprises only two genera, namely *Eudendrium* Ehrenberg, 1834

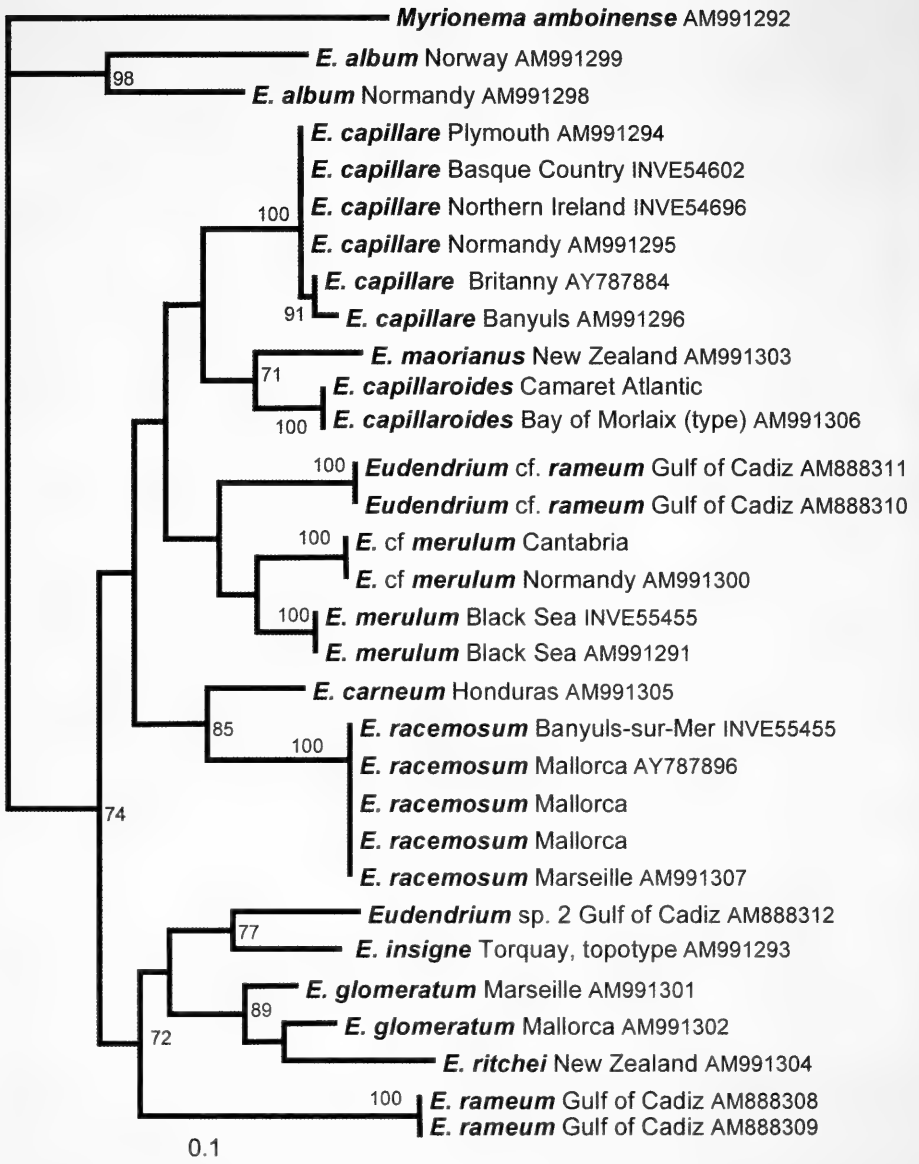


FIG. 2

Maximum Likelihood analysis of the partial 16S sequence differences of Eudendriidae samples discussed in this publication (HKY substitution model, indels ignored). Small numbers next to nodes indicate percent bootstrap support (only shown if >70%). The length of the sum of the horizontal lines is a measure of the sequence difference. The taxon labels are composed of the species name, the sampling region, followed by the EMBL/GenBank accession number or the voucher number if the sample has the same sequence as other known sequences (if available, see list of examined material for each species).

and *Myrionema* Pictet 1893. The latter genus is characterized by a large (>35) number of tentacles arranged in more than one whorl. In the ERMS region (European Register of Marine Species; Costello *et al.*, 2001), only the genus *Eudendrium* is present. Some earlier Mediterranean records of *Myrionema* species are likely due to confusions with *E. moulouyensis* (comp. Marques *et al.*, 2000b). Another problematic species is *Myrionema multicornis* discussed at the end of this treatise.

Genus *Eudendrium* Ehrenberg, 1834

TYPE SPECIES: *Tubularia ramosa* Linnaeus, 1758 [designation by Allman, 1872].

SYNONYMS (after Calder, 1988): *Calamella* Oken, 1815: 55 [invalid name, ICZN Opinion 417]. – *Corymbogonium* Allman, 1861: 171. – *Edendrium* Allman, 1872 [incorrect spelling]. – *Erudendrium* Thompson, 1899 [incorrect spelling].

DIAGNOSIS: Eudendriidae with tentacles in one whorl, of varied number but usually fewer than 35.

REMARKS: For the taxonomic history see Calder (1988). Although Ehrenberg (1834) translates the genus name as "Pracht-Polyp" [splendour polyp], the name is likely derived from the Greek words "eu" (pleasing, good) and "dendron" (tree). The grammatical gender is neuter.

The species are here grouped and discussed according to their complimentary nematocyst types (instance 1 in the following key) and apparent similarity in order to allow an easier comparison. However, this does not imply a phylogenetic order.

KEY TO *EUDENDRIUM* SPECIES IN THE ERMS ZONE (PROBLEMATIC SPECIES EXCLUDED):

- | | | |
|----|---|----------------------|
| 1a | complementary nematocysts are large macrobasic euryteles (shaft length $s > 2.5$) | 2 |
| 1b | complementary nematocysts are small or large haplonemes (iso- or an-izorhizas) | 5 |
| 1c | complementary nematocysts are microbasic euryteles (shaft length $s < 2.5$), either distinctly larger than tentacular euryteles or only slightly larger (1.3 times) | 7 |
| 1d | without complementary nematocysts or these haplonemes of same size as tentacular euryteles | 16 |
| 2a | macrobasic euryteles in buttons on hydranth body | 3 |
| 2b | macrobasic euryteles scattered on hydranth body, not in buttons | 4 |
| 3a | colonies large, usually polysiphonic, shaft of intact macrobasic eurytele in 2.5 loose coils | <i>E. glomeratum</i> |
| 3b | colonies monosiphonic, female blastostyles after fertilization reduced to nematocyst knobs, shaft of intact macrobasic eurytele in more than 2.5 coils along capsule wall | <i>E. cnidiferum</i> |
| 4a | macrobasic euryteles with 3-5 coils oblique to long axis, gonochoristic | <i>E. album</i> |
| 4b | macrobasic euryteles with coils along long axis, female sporosac often with sperm chamber, usually on the Mediterranean sea grass <i>Posidonia oceanica</i> | <i>E. simplex</i> |

- 5a haplonemes small ($< 10 \mu\text{m}$), colonies monosiphonic or stem base composed of a few tubes only 6
- 5b strongly polysiphonic, no cnidophores, haplonemes large ($> 20 \mu\text{m}$)
 *E. carneum*
- 6a spadix of female sporosac bifid, some hydranths with cnidophores, large colonies *E. racemosum*
- 6b spadix of female sporosac simple, complimentary nematocysts are small haplonemes of same size as tentacular euryteles, presence variable, often absent, colonies small and delicate *E. capillare*
- 7a shaft in intact complimentary microbasic euryteles straight 8
- 7b shaft in intact complimentary microbasic euryteles with a coil 15
- 8a colonies large, trunk or base polysiphonic 9
- 8b colonies monosiphonic or stem-base made up of a few tubes only 11
- 9a complementary euryteles scattered on body, colony tree-like *E. rameum*
- 9b complementary euryteles forming a contiguous belt on body 10
- 10a colony more tree-like, stems usually with bark-like covering, hydranths large ($>0.4 \text{ mm}$ diameter), blastostyles aggregated on upper side of branches, pedicels relatively short *E. annulatum*
- 10b colonies more bush-like, stem without bark-like covering, hydranths small ($<0.3 \text{ mm}$ diameter), blastostyles dispersed *E. arbuscula*
- 11a with zooxanthellae in gastrodermis *E. moulouyensis*
- 11b without zooxanthellae 12
- 12a complimentary eurytele large, more than two times as large as tentacular euryteles 13
- 12b complimentary eurytele small, only 1.3 times as large as tentacular capsules *E. capillaroides* n. sp.
- 13a gonophores develop on normal or slightly reduced hydranths 14
- 13b gonophores develop on blastostyles without vestiges of a hydranth, shaft of discharged large euryteles with thick spines *E. cf. merulum*
- 14a colonies much branched, monosiphonic or exceptionally with few tubes near base, large euryteles scattered on body, spadix without swelling *E. ramosum*
- 14b colonies sparingly branched, large euryteles concentrated in belt on body, spadix of female sporosac with distal triangular swelling (axe-like shape) *E. calceolatum*
- 15a colonies usually polysiphonic, perisarc annulated throughout, thick, brown, lower half of hydranth in perisarc collar, coil size of shaft in large eurytele rather small *E. vaginatum*
- 15b colonies monosiphonic, perisarc thin, with smooth and annulated stretches, hydranth without perisarc collar, coil size of shaft in large eurytele about 1/4 or more of capsule length *E. unispirum*
- 16a female gonophores with spadix 17

- 16b female gonophores without spadix, eggs attached via long pedicels to normal hydranths *E. vervoorti*
- 17a colonies polysiphonic, some hydranths modified into long nematophores, without complimentary nematocysts *E. armatum*
- 17b colonies monophonic, no nematophores, without complimentary nematocysts or sometimes with small haplonemes of the same size as tentacular capsules *E. capillare*

***Eudendrium glomeratum* Picard, 1952**

Figs 3-4

Eudendrium ramosum. – Browne, 1897: 243. – Motz-Kossowska, 1905: 54, pl. 3 fig. 16. [not *Eudendrium ramosum* (Linnaeus, 1758)]

Eudendrium arbuscula. – Schneider, 1898: 477. [not *Eudendrium arbuscula* Wright, 1859]

Eudendrium pusillum. – Jäderholm, 1916: 3. – Watson, 1985: 213. [not *Eudendrium pusillum* Lendenfeld, 1885: 352, = *E. lendenfeldi* Briggs, 1922]

? *Eudendrium indopacificum* Stechow, 1924: 59. [new name for *E. pusillum* in Thornely, 1904]

Eudendrium glomeratum Picard, 1951b: 260. [nomem nudum]

Eudendrium glomeratum Picard, 1952: 338, new name. – Castric & Michel, 1982: 82, fig. – Watson, 1985: 213, figs 89-94. – Boero *et al.*, 1986: 81-85, fig. 1. – Boero & Cornelius, 1987: 244. – Marinopoulos, 1992: 59, fig. 1.9. – Watson, 1999: 7, fig. 5A-D. – Marques *et al.*, 2000a: 96, figs 53-56. – Marques *et al.*, 2000b: 205. – Peña Cantero & García Carrascosa, 2002: 29, fig. 4c-f. – Puce *et al.*, 2005: 202, figs 1d, 2i.

MATERIAL EXAMINED: MHNG INVE29456; Mediterranean, France, Banyuls-sur-Mer, depth 2m, 14 Sept. 1995; fertile female. – MHNG INVE29457; Mediterranean, France, Banyuls-sur-Mer, 8 March 1993; 10 cm high, polysiphonic, infertile. – MHNG INVE32159; Mediterranean, Spain, Mallorca, Cala Murada; depth 2m; 27 July 2001; small polysiphonic colony on red algae, fertile female, hydranths intensively orange; 16S sequence accession number **AM991302**. – MHNG INVE39462; Mediterranean, France; 26 Nov. 1953, depth 40m. – MHNG INVE39473; Mediterranean, France, Marseille, Riou-impériaux de Terre; depth 20m; 20 March 1966, two large infertile colonies. – MHNG INVE39717; Mediterranean, France, Marseille; depth 40m; 28 Sept. 2004; 15 cm colony, hydranths reddish; 16S sequence accession number **AM991301**. – Italy, Sardinia, depth 25m; October 2005; fertile female, 5 cm colony; in private collection of Dr S. Puce.

DIAGNOSIS: Colonies usually tall, polysiphonic when fully grown, with large macrobasic euryteles arranged in buttons or belt around hydranth body. Male and female blastostyles atrophied; spadix unbranched when immature, shed when mature. Hydranths red.

DESCRIPTION: Colonies large, bushy or tree-like, irregularly branching, when reproductive usually stems and some branches polysiphonic, monosiphonic stems can occur. Perisarc thick, smooth, occasionally some annulated stretches, usually at bases of branches. Hydranths with 15-27 tentacles (mostly 20-22), on hydranth body a ring composed of several nematocyst buttons (4-10), these buttons can coalesce into an irregular band, buttons can also be scattered on hydranth body. Tentacles with nematocysts along entire length but density decreasing towards proximal, in bands with arrays of 3-4 capsules, capsules oriented parallel to surface and tentacle surface thus smooth. Colours: older perisarc brown; hydranth characteristically red.

Male gonophores two-chambered and borne on blastostyles lacking tentacles at all stages; with or without terminal buttons; clusters of macrobasic euryteles can be present at base of blastostyle and at end of gonophores, not always in the terminal buttons.

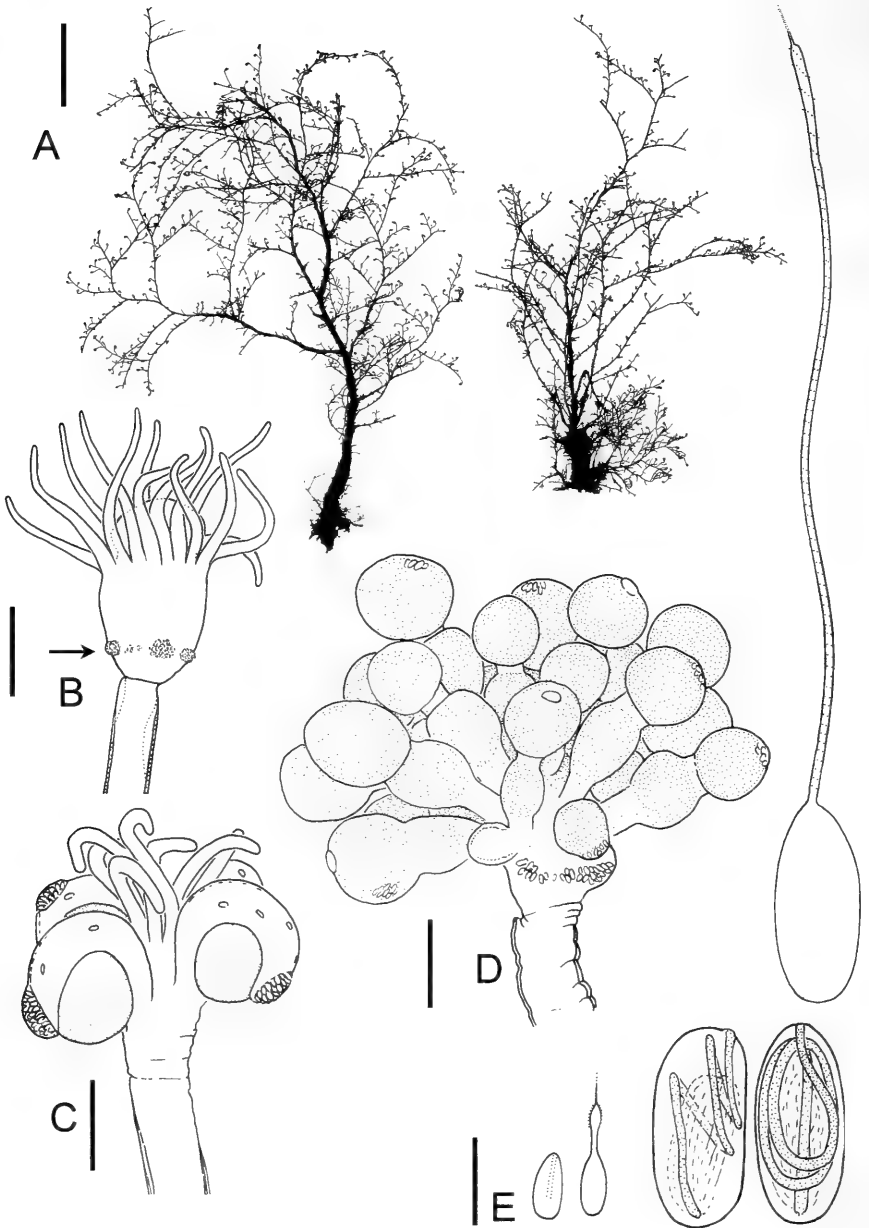


FIG. 3. *Eudendrium glomeratum* Picard, 1952, after preserved Mediterranean material, except E (native capsules). (A) Silhouettes of typical colonies (MHNG INVE39473), scale bar 2 cm. (B) Hydranth with characteristic nematocyst buttons (arrow), scale bar 0.5 mm. (C) Young female blastostyle (MHNG INVE32159), scale bar 0.2 mm. (D) Male blastostyle, note nematocysts at base of blastostyle, material from Sardinia, scale bar 0.2 mm. (E) Nematocysts (MHNG INVE39717): intact and discharged microbasic eurytele, two intact macrobasic euryteles in side and frontal view, above discharged macrobasic eurytele, scale bar 10 μ m.

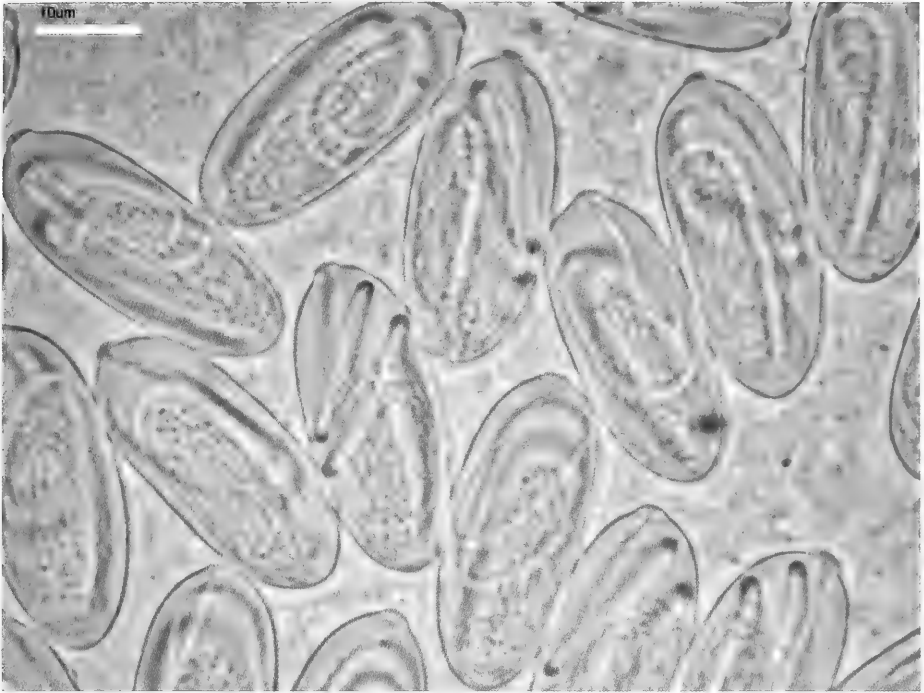


FIG. 4

Eudendrium glomeratum Picard, 1952, native macrobasic euryteles; MHNG INVE39717.

Female gonophores develop on reduced hydranth with few tentacles (up to 8), hydranth body small, hypostome absent, 4-6 gonophores per blastostyle, spadix simple, with one or more nematocyst buttons near tip, spadix later atrophied, also tentacles are lost during later development, eggs ultimately attached to blastostyle pedicels. Incipient oogonia visible in coenosarc of branches.

Nematocysts: microbasic euryteles, on tentacles; macrobasic euryteles in nematocyst buttons, shaft in intact capsule in about 2-3 loops following long axis of capsule, discharged about four times the length of the capsule, barbed.

DIMENSIONS: Height of reproductive colonies from a few cm to about 15 cm; hydranth diameter about 0.5 mm, variable even within the same colony; diameter of basal stem tubes 0.4-0.5 mm. Macrobasic euryteles in Mediterranean animals $(22-33) \times (9.5-13.5) \mu\text{m}$, $r = 2.2-2.4$ (Marinopoulos, 1992; Marques *et al.*, 2000b; Peña Cantero & García Carrascosa, 2002; own data). Australian values show more variation (Watson, 1985; 1999). Microbasic euryteles $(6-10) \times (3-5) \mu\text{m}$, $r = 2.1-2.3$ (Peña Cantero & García Carrascosa, 2002; Watson, 1985; own data).

BIOLOGY: Occurs on various solid substrata in depths of 0-200 m (Peña Cantero & García Carrascosa, 2002), more commonly in depths of 10-40 m (Fey, 1970; Boero *et al.*, 1986). In the Mediterranean, fertile colonies can be found all year round (Peña Cantero & García Carrascosa, 2002; own data), but the peak of reproduction seems to

be during autumn and winter (Boero, 1984; Boero *et al.*, 1986). In the Atlantic, reproductive colonies have been found from June to October (Fey, 1970; Peña Cantero & García Carrascosa, 2002). More ecological data are given in Boero (1981), Boero & Fresi (1986), Boero *et al.* (1986), Arillo *et al.* (1988), and Bavestrello *et al.* (1994). Some colonies can be aggregates of colonies (Bavestrello & Cerrano, 1992).

DISTRIBUTION: Rather common and widespread in the western and eastern Mediterranean, including the African and Israeli coasts (see e. g. Marques *et al.*, 2000b and 2000b; Peña Cantero & García Carrascosa, 2002). In the western Atlantic known from the British Isles (Boero & Cornelius, 1987) (not in North Sea), Brittany (Teissier, 1965; Fey, 1970; Castric *et al.*, 1987), Northern Spain (Medel & López-González, 1996). Further records are known from Australia (Watson, 1985; 1999) and Brazil (Marques, 1993; cited in Peña Cantero & García Carrascosa, 2002). Type locality: Mediterranean, France, Banyuls-sur-Mer (Boero & Cornelius, 1987).

REMARKS: With its large colonies and the macrobasal euryteles in warts on the hydranth, *Eudendrium glomeratum* is relatively easily identifiable. Despite this and its relative abundance in the Mediterranean, it was described and recognized rather late. Many older records of *E. rameum* and even *E. ramosum* were therefore actually based on *E. glomeratum* (Marques *et al.*, 2000a).

***Eudendrium cnidiferum* Stechow, 1919**

Fig. 5

Eudendrium armatum Jäderholm, 1907: 372. – Jäderholm, 1909: 52, pl. 4 figs 7-9.

[not *Eudendrium armatum* Tichomiroff, 1887]

Eudendrium cnidiferum Stechow, 1919: 154, new name.

TYPE MATERIAL EXAMINED: SNHM type 4274, Syntype colonies of *Eudendrium armatum* Jäderholm, 1907; loc. Bohuslän.

DIAGNOSIS: Monosiphonic colonies, hydranths with nematocyst buttons containing large macrobasal euryteles, female blastostyles after fertilization reduced to nematocyst knobs.

DESCRIPTION: Colonies on algae, monosiphonic, much branched, branching irregular, branches long. Perisarc mostly smooth, some annulation present, annulation usually present at origin of new branches and hydranth pedicels. Hydranths typical for genus but relatively small, 22-24 tentacles, near base wart-like nematocyst clusters with macrobasal euryteles.

Only advanced, presumably fertilized, egg stages present, these encapsulated and attached in whorls around pedicels of former blastostyles (Fig. 5B-C). Former blastostyle reduced to nematocyst knobs at end of pedicels.

Nematocysts: tentacular microbasal euryteles and large macrobasal euryteles in nematocyst buttons, shaft discharged more than four times as long as capsule, in undischarged capsule shaft coiled several times, coils along capsule wall and apparently filling capsule.

DIMENSIONS: Stems about 6 cm high, basal stem diameter 0.25 mm, hydranth pedicel diameters 0.14-0.17 mm. Preserved microbasal euryteles from tentacles (7-7.5) × (3-3.5) μm, r = 2-2.5; macrobasal euryteles (20.5-24) × (7.5-8.5) μm, r = 2.6-3.0.

DISTRIBUTION: Only known from the type locality, Bohuslän, Sweden.

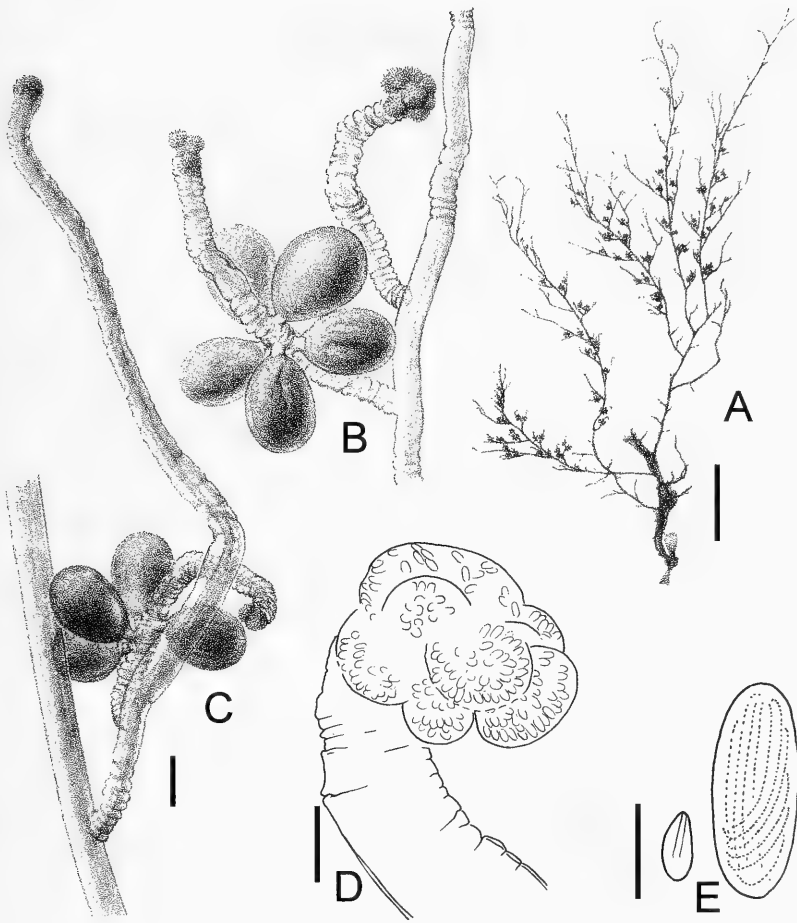


FIG. 5

Eudendrium cnidoferum Stechow, 1919, after syntype material, A-C modified from Jäderholm (1909). (A) Several stems, scale bar 1 cm. (B-C) Branches with encapsulated eggs/embryos. (D) Terminal portion of a blastostyle pedicel with nematocyst buttons. (E) Small microbasic eurytele and large macrobasic eurytele, the internal structure was only indistinctly visible, bar 10 μm .

REMARKS: When Jäderholm (1907) described *Eudendrium armatum* as new species, he was likely unaware that this name was already in use as *Eudendrium armatum* Tichomirowff, 1887. Stechow (1919) therefore proposed the replacement name *E. cnidoferum*, thus becoming also the author of the taxon. The species is only known from its type specimen and it was characterized by Jäderholm (1909) by what he considered the blastostyles. The eggs are attached in a whorl around a perisarc covered pedicel, the latter ending in several buttons full of large nematocysts (Fig. 5B, D), resembling the ends of tentaculozooids of *Hydractinia echinata*. Jäderholm considered them to be specialized nematophores. A re-examination of the type specimen confirmed Jäderholm's observation, but the blastostyles must be re-interpreted.

Additionally, although only very few hydranths are left, these have nematocyst buttons near the base of hydranth, just like in *E. glomeratum* (Fig. 3B). The gonophores are actually encapsulated – likely fertilized – eggs or embryos attached to the former pedicel of the blastostyle, as usually found in the final stages of the sequence of the development of the female sporosac (see General Morphology section). As in other *Eudendrium* species, the blastostyles became reduced once the eggs had been fertilized and what we see are likely only the vestiges of the former blastostyles. As also the blastostyles can have nematocyst buttons (e. g. *E. glomeratum*, Fig. 3C-D), these buttons might be the sole remainder of the former blastostyle. Nevertheless, they could be a constant feature of the species and perhaps allow a distinction from the otherwise almost identical *E. glomeratum*. There are only a few traits that would allow distinction of *E. glomeratum* from *E. cnidiferum*. The latter forms a monosiphonic colony, while the former species forms normally polysiphonic colonies, although Marques *et al.* (2000b) also report monosiphonic colonies. Perhaps also the undischarged large euryteles of the two species differ slightly. While in *E. glomeratum* the shaft makes only a few loose coils (Fig. 4), it seems to fill the capsule in *E. cnidiferum* (Fig. 5E). However, this observation is to be taken with some caution as the old material of *E. cnidiferum* did not permit a detailed, reliable observation of this trait.

Eudendrium cnidiferum remains an insufficiently known species and a conclusive evaluation of the status of can only be made once new material from Bohušlán becomes available. It seems nevertheless advisable to retain it as a valid species for the time being.

Eudendrium album Nutting, 1896

Figs 6-7

Eudendrium album Nutting, 1896: 146. – Nutting, 1898: 362, pl. 14, fig. 1. – Nutting, 1901: 334, fig. 11. – Kingsley, 1910: 20, pl. 2 fig. 11. – Fraser, 1912: 348, fig. 5 A-B. – Billard, 1927: 327. – Fraser, 1944: 61, pl. 7 fig. 32. – Leloup, 1947: 107: 18, fig. 9. – Leloup, 1952: 124, fig. 61. – Calder, 1971: 45, pl. 3 fig. B. – Watson, 1985: 185. – Marques *et al.*, 2000a: 77, figs 1-7. – Faasse & Vervoort, 2005: 58, figs 1-2.

not *Eudendrium album*. – Pennycuik, 1959: 167.

Eudendrium fragile Motz-Kossowska, 1905: 58, fig. 1, pl. 3 fig. 17. **new synonym**

Eudendrium fragile. – Marinopoulos 1992: 59, fig. 1. 11. – Boero & Freesi, 1986: 141. – Marques *et al.*, 2000a: 206. – Puce *et al.* 2005: 202, figs 1c, 2d, 2h.

Eudendrium islandicum Schuchert, 2000: 417, fig. 4. **new synonym**

Eudendrium islandicum Schuchert, 2001a: 29, fig. 17.

MATERIAL EXAMINED: BMNH 1912.12.21.85; as *Eudendrium album*; marked with red ink as “? type specimen”; A. M. Norman Collection; England, Plymouth; infertile, nematocysts not identifiable. – BMNH 1948.9.8.83; as *Eudendrium album*; England, Plymouth; 11 May 1898; female; E.T. Browne collection; has typical macrobasal euryteles. – BMNH 1948.9.8.81; as *Eudendrium album*; England, Plymouth; 11 May 1898; *Nemertesia antennina*; infertile; coll. E.T. Browne; nematocysts not preserved. – MHNG INVE37297; as *Eudendrium album*; France, Normandy, Cotentin, Herquemoulin, Treize Vents; 22 Aug. 2005; on *Halopitys incurvus*; male and female colonies; male sporosacs on fully formed hydranth, female likewise, 16 S sequence **AM991298**. – Norway, near Bergen, Flesland beacon, depth 20-100m; 20 June 2006; infertile colony on rock; has typical macrobasal euryteles; not preserved, **AM991299**. – BELUM Md617; Northern Ireland, Strangford Lough Narrows, W of Rue Point; 54.365°N 05.542°W; depth 7m; 02 Aug. 1983; female. – BELUM Md623; Northern Ireland, Strangford Lough Narrows, W of Rue Point; 54.365°N 05.542°W; depth 25m; 03 Aug. 1983; infertile. – BELUM Md618; Northern Ireland, Strangford Lough Narrows, W of Rue Point; 54.365°N 05.542°W; 25m; 03 Aug. 1983; female. – BELUM Md107; Northern Ireland, Mulroy Bay, Cranford, Broad Water,

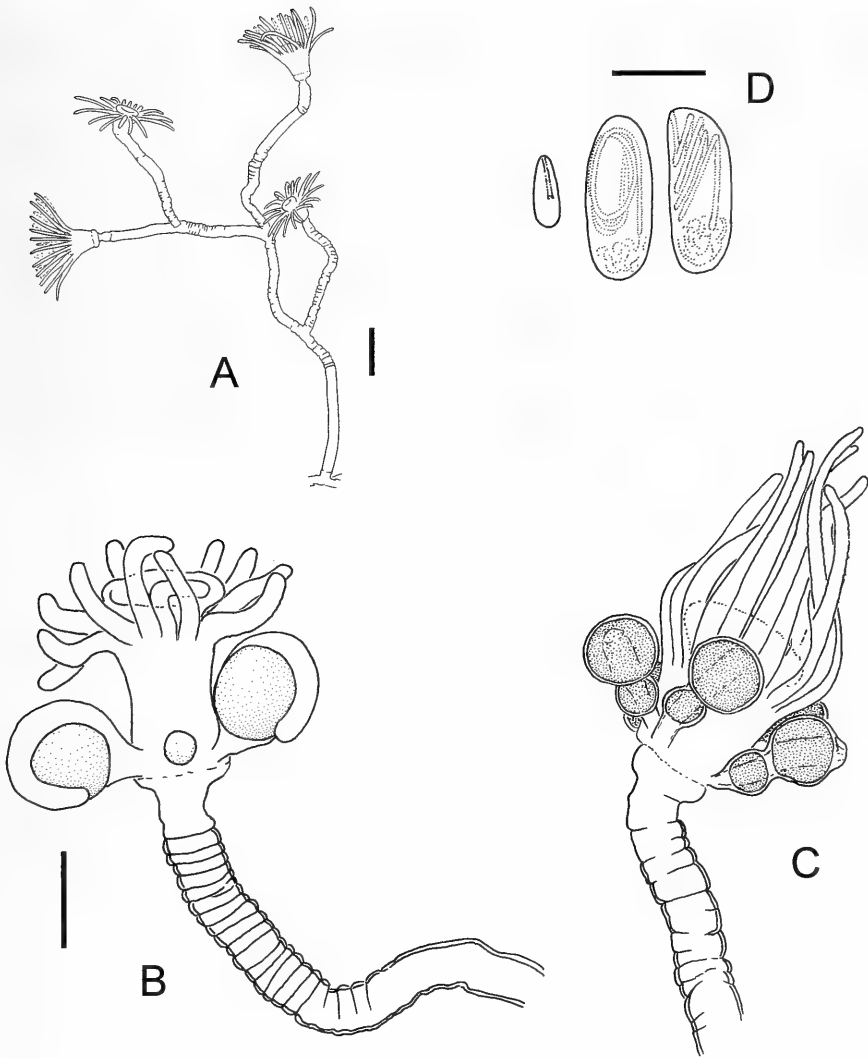


FIG. 6

Eudendrium album Nutting, 1896; after preserved material from the English Channel. (A) Colony from intertidal region, scale bar 0.5 mm. (B) Hydranth with female sporosacs, scale bar 0.2 mm. (C) Hydranth with male sporosacs, same scale as B. (D) Nematocysts: microbasic eurytele; two macrobasic euryteles, left frontal view, right lateral view. Scale bar 10 μ m.

Deegagh Point; 55.152°N 07.690°W; depth 10m; 25 March 1978; infertile. – BELUM Md106, as *Eudendrium ramosum*; Northern Ireland, Strangford Lough, E of Strangford; 54.373°N 05.554°W; depth 3m; 07 June 1976; female.

DIAGNOSIS: Colonies monosiphonic, small, gonochoristic; male and female sporosacs on normal hydranths; spadix simple; complementary nematocyst macrobasic eurytele; shaft inside capsule coiled obliquely in relation to long capsule axis, coil diameter max. 2/3 of capsule.

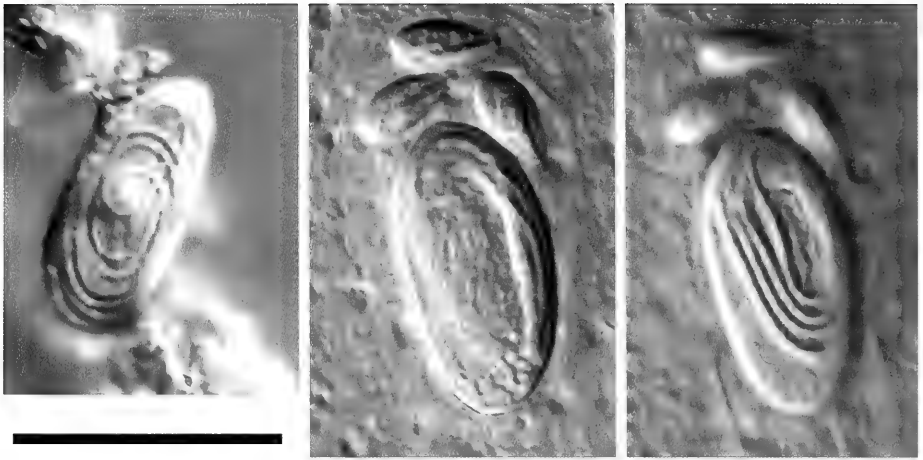


FIG. 7

Eudendrium album Nutting, 1896; nematocysts, living material from Norway. The two images at right depict the same capsules, but in different focusing planes.

DESCRIPTION: Colonies arising from creeping, branching stolons; stems monosiphonic, irregularly branched, 1-20 hydranths per shoot (up to 50 possible), shallow-water colonies small, Mediterranean colonies sometimes stolonial, cold-water colonies larger. Perisarc smooth with some corrugated or annulated stretches, perisarc of stem brown to yellowish, branches yellowish-brown fading to colourless. Hydranths cup-shaped as somewhat tapering towards base, hypostome rounded, large, around 17-22 tentacles; basal third of tentacles nearly free of nematocysts, in more distal region nematocysts in rings, capsule almost perpendicular to tentacles thus rendering it spiny. Colonies gonochoristic. Living hydranths of English Channel white to cream coloured, perisarc of preserved material yellowish.

Female gonophores develop in one whorl on body of a normally developed hydranth, about six sporosacs, initially with a simple curved spadix; hydranths can be somewhat reduced with ongoing gonophore maturation.

In older stages spadices shed and the embryos in their transparent capsules attached irregularly along the pedicel of the former blastostyle.

Male gonophores 2-3 (mostly 2) chambered, arising as single whorl from lower part of the body of either normally developed or only very slightly reduced hydranths, 6-8 gonophores, with or without distal button on last chamber, button if present without concentration of nematocysts. Nematocysts: small microbasic eurytele on tentacles, almond-shaped; larger macrobasic eurytele, shaft in intact capsule in 4-5 coils that are oblique in relation long axis of capsule (in side view), confined to upper 2/3 of capsule (Figs 6D, 7).

DIMENSIONS: Colony height is from a few mm in the intertidal region to 7 cm in deep waters. Hydranths 0.4-0.7 mm. Diameter of stems at base 0.12-0.20 mm, branches thinner. Nematocysts (preserved material): microbasic eurytele (7-8) \times (2.5-4) μ m, $r = 2.0-2.8$; macrobasic eurytele, size (18.5-27) \times (7.5-14) μ m, $r = 2.0-2.7$, $s > 5$.

BIOLOGY: Occurs from the intertidal to about 1000 m depth (deep-water records as *E. islandicum*). In the English Channel, gonophores are present from at least January to August (Russell, 1957, own observations). It occurs on stones, algae and other hydroids. More data on the biology of the American population are given in Calder (1971, 1976, 1990).

DISTRIBUTION: Mediterranean to North Atlantic. Only a minority of the known records are based on identifications that include nematocyst information. Without this information, identifications should be considered as tentative only. In the eastern Atlantic ranging from Galicia (Spain) to Norway (e. g. Nutting, 1898; Billard, 1927; Leloup, 1947, 1952; Russell, 1957; Teissier, 1965; Altuna Prados, 1994; Medel & López-González, 1996; Marques *et al.*, 2000b; Faasse & Vervoort 2005; this study). Has also been recorded in the Black Sea (Manea, 1977). In the western Mediterranean, it is known under the name *E. fragile* (Motz-Kossowska, 1905; Boero & Freesi, 1986; Marinopoulos, 1992; Marques *et al.* 2000b; Puce *et al.*, 2005). As *E. islandicum* it has been recorded from Iceland (Schuchert, 2000) and southern- to southwestern Greenland (Schuchert, 2001). Along the American continent it is known from the Gulf of St. Lawrence to Florida (Fraser, 1944; Calder, 1971, 2003). The following records must be confirmed again: California (Fraser, 1948) and Gulf of Mexico (Deevey, 1954). Type locality: Shallow waters near Millbay Channel, Plymouth, Great Britain.

REMARKS: Nutting (1898) regarded the small colony size and the white hydranths as diagnostic for this species. Colour is often not a reliable trait to distinguish species and the identity of *E. album* from Plymouth is not entirely clear as no unambiguous type material exists. The BMNH has a specimen from Plymouth marked with red ink as "? type". The specimen is from the Norman collection and there is no indication that it was obtained from Nutting. Furthermore, the material is infertile and does thus not correspond to Nutting's first description where he mentions fertile material. It is thus unlikely that it is the type specimen. The nematocysts of this specimen are too poorly preserved to be identified. Other potential type material could not be found and it must be assumed that no type material has survived (a potential type specimen formerly present in the Smithsonian Institution is likely lost; Dr A. Collins, pers. comm.). The BMNH has other, non-type samples of *E. album* from Plymouth, two of which still have identifiable nematocysts. The colony morphology of both match Nutting's description. Based on the nematocysts, one of them has macrobasic euryteles, while the other has apparently different nematocysts (see *Eudendrium unispirum*).

A search for *Eudendrium* species at and near the type locality (Millbay Channel, Plymouth) in June 2007 produced only *E. capillare*.

The scope and identity of *Eudendrium album* is thus not entirely clear, but Watson (1985) and Marques *et al.* (2000a) have re-defined this species by stating that its identification depends on the presence of macrobasic euryteles. As this form is apparently not uncommon in the English-Channel (see material examined) and thus might correspond to the Nutting's original species, it is advisable to maintain this usage. In order to stabilize the nomenclature, it might be necessary to designate a neotype based on fertile material of which the 16S and COI sequences are known.

Eudendrium fragile Motz-Kossowska, 1905 as re-defined in Marinopoulos (1992), Boero & Fresi (1986), and Marques *et al.* (2000b), appears indistinguishable from *E. album* and both are here regarded as conspecific.

Eudendrium islandicum Schuchert, 2000 is not objectively separable from *E. album*. *Eudendrium islandicum* has somewhat larger colonies than *E. album*, a feature likely attributable to the deeper and colder waters it was taken from. Apart from the colony size and the biogeographic zone (cold boreal to Arctic waters), there is thus nothing that would allow distinguishing them and they must therefore be regarded as conspecific.

The 16S sequences of two colonies of *E. album*, one originating from the intertidal of English Channel, the other from deeper waters in Norway, could be compared (Fig. 2). Although both colonies and their nematocysts appeared indistinguishable, the sequences were rather divergent, suggesting a possible cryptic speciation (or *E. islandicum* could nevertheless be valid, separable on biogeographic grounds).

***Eudendrium simplex* Pieper, 1884**

Fig. 8

Eudendrium simplex Pieper, 1884: 150. – Motz-Kossowska, 1905: 56, pl. 3 figs 18-19. – Stechow, 1919: 30. – Marques *et al.*, 2000b: 205. – Bouillon *et al.*, 2004: 61, figs 36M-P.

Eudendrium motzkossowskiae Picard, 1952: 339. – Marques *et al.*, 2000b: 206, synonym. – Boero, 1981: 188, fig. 4. – Marinopoulos, 1992: 59, fig. 1.10. – Boero & Fresi, 1986: 141.

? *Eudendrium motzkossowskiae*. – Millard & Bouillon, 1974: 17, fig. 3J-K. – Millard, 1975: 84, fig. 29G-H.

MATERIAL EXAMINED: MHNG INVE27128, as *Eudendrium motzkossowskiae*; Mediterranean, Mallorca, Cala Murada, depth 4m, on *Posidonia oceanica*; 26 Aug. 1999; male and female colonies. – Ionian Sea, Italy, S. Caterina; 27 Nov. 2001 and 11 Oct. 2006; fertile colonies; preserved material in pers. collection Doris De Vito.

DIAGNOSIS: Usually on *Posidonia oceanica*, stolonial or sparingly branched colonies, large macrobasic eurytele with several coils along long axis, blastostyles normal hydranths, spadix of female sporosacs often with a chamber containing male gametes.

DESCRIPTION: Colonies stolonial or sparingly branched with up to four hydranths per stem. Stolons creeping, ramified. Perisarc of stems smooth with some annulated or corrugated stretches, variable. Hydranths typical for genus, around 20 tentacles, basal grove visible, above basal grove large nematocysts, but not dense, few more large capsules scattered on other parts of hydranth. Male and female colonies separate, gonophores develop on normal hydranths that are not or only minimally reduced.

Male blastostyles with 1-4 sporosacs, two-chambered, no terminal nematocyst button (Fig. 8D).

Female blastostyles with 2-5 sporosacs, spadix simple, curved, bearing few scattered nematocysts, spadix in advanced stage often with one or rarely more bump-like swelling due to a chamber containing spermatogenic cells (Fig. 8C). Fertilized eggs form membranous perisarc capsule and get attached to pedicels of blastostyles (Fig. 8B).

Nematocysts: small microbasic euryteles on tentacles; large macrobasic euryteles, discharged shaft very long ($r > 4$), densely barbed (holotrichous), shaft in

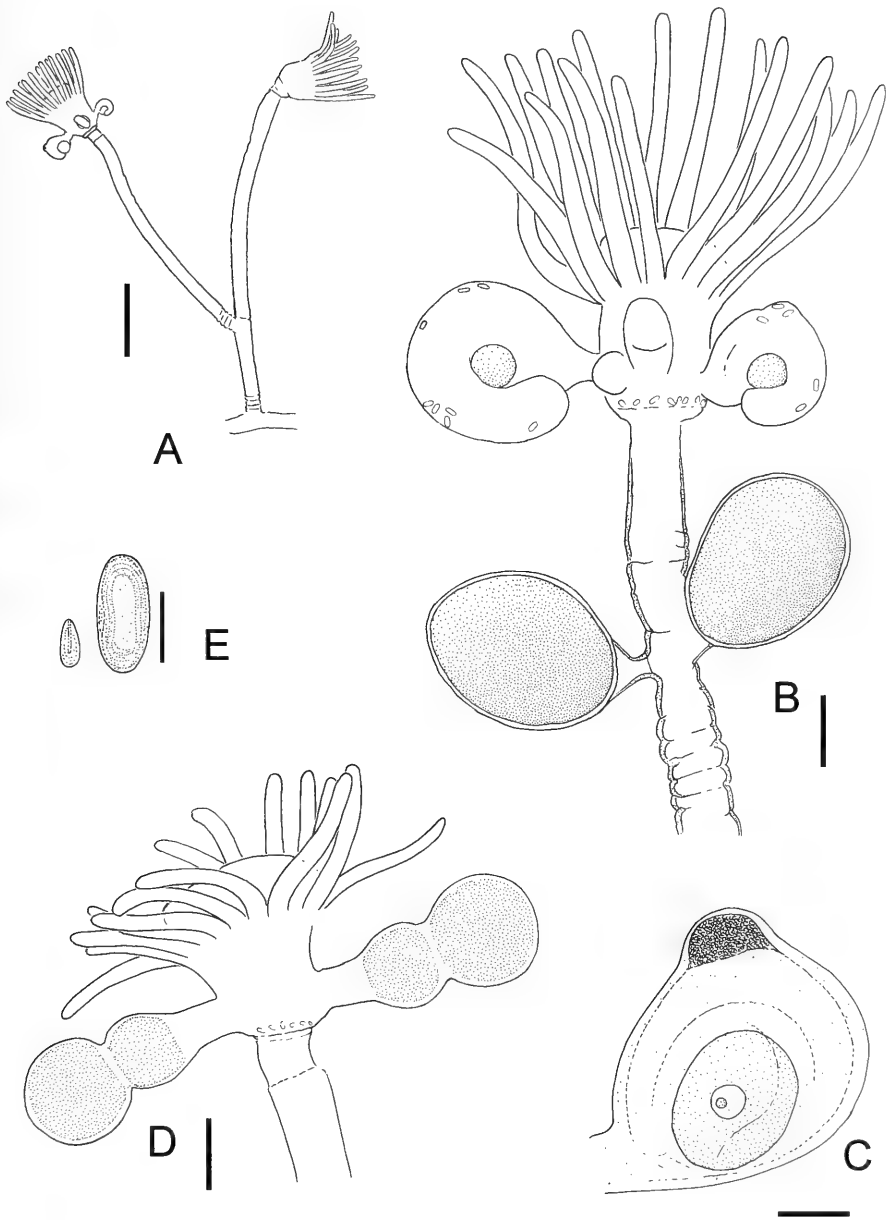


FIG. 8

Eudendrium simplex Pieper, 1884; after preserved Mediterranean material. (A) Stem with two hydranths, scale bar 0.5 mm. (B) Blastostyle (gonozooid) with developing female sporosacs and two encapsulated embryos attached to pedicel, scale bar 0.1 mm. (C) Optical section of female sporosac with mass of spermatogenic cells on spadix, scale bar 50 μm . (D) Blastostyle with male sporosacs, same scale as B. (E) Undischarged nematocysts: microbasic and macrobasic euryteles, scale bar 10 μm .

undischarged capsule in more than four coils along the capsule wall and oriented parallel to long axis.

DIMENSIONS: Stems up to 12 mm, hydranth pedicel diameter 0.08-0.090 mm, stem diameter at base ca. 0.1 mm, hydranth height 0.25-0.3 mm, encapsulated embryos 0.2-0.25 mm. Microbasic euryteles $(6-6.5) \times (2.5-3.5) \mu\text{m}$, $r=2.0-2.6$. Macrobasic euryteles $(16-19) \times (6.5-8.5) \mu\text{m}$, $r=1.7-2.5$. For more nematocyst measurements see Marinopoulos (1992) and Marques *et al.* (2000b).

BIOLOGY: Occurs in shallow water (down to 15 m), predominantly or perhaps exclusively on *Posidonia oceanica*. Mature from April to November (Gili & Garcia Rubies, 1985; Bouillon *et al.*, 2004; own data).

DISTRIBUTION: Mediterranean (Marques *et al.*, 2000b). The records from southern Africa (Millard & Bouillon, 1974; Millard, 1975; as *E. motzkossowskiae*) are uncertain as no hermaphroditic sporosacs were observed. Type locality: Dalmatian coast, Adriatic Sea.

REMARKS: The synonymy of this species was outlined by Marques *et al.* (2000b). If present, the unique hermaphroditic sporosacs allow a reliable identification of this species. Its occurrence on *Posidonia oceanica* also helps to identify it. *Eudendrium fragile*, a subjective synonym of *E. album*, is otherwise quite similar, but the macrobasic euryteles differ slightly (comp. Figs 7 and 8E).

Eudendrium racemosum (Cavolini, 1785)

Figs 9-10

Sertolara racemosa Cavolini, 1785: 160, pl. 6 figs 1-7, 14-15.

Sertularia racemosa Gmelin, 1788: 3854.

Eudendrium racemosum. – Ehrenberg, 1834: 296. – Allman, 1872: 341. – Morri, 1981: 59, fig. 18, pl. 1 fig. – Gili, 1982: 42, fig. 10. – Gili & Castello, 1985: 11, fig. 2. – Watson, 1985: 204, figs 63-67. – Marinopoulos, 1992: 60, figs 1.1, 2, 5. – Marques *et al.*, 2000a: 100, figs 67-70. – Marques *et al.*, 2000b: 207. – Peña Cantero & García Carrascosa, 2002: 33, fig. 6. – Puce *et al.*, 2005: 302, figs. 1f, 2m. – Puce *et al.*, 2006: 622, fig. 4a-c.

? *Eudendrium racemosum*. – Stechow, 1913: 63. – Yamada, 1954: 5, fig. 4. – Hirohito, 1988: 84, fig. 29.

not *Eudendrium racemosum mucronatum* Billard, 1926: 88, fig. 8.

MATERIAL EXAMINED: BELUM Md1005; Atlantic, France, Brittany, Anse de Camaret; 4 Aug. 1986. – MHNG INVE25854; France, Corsica, Calvi; depth 2m; 6 Jul. 1992; fertile female and male colonies. – MHNG INVE26505; Mediterranean, France, Banyuls-sur-Mer; depth 4m; male colony; 12 Jul. 1999. – MHNG INVE27671; Spain, Canary Islands, Lanzarote; 23 Sep 1999; depth 25-30m; male. – MHNG INVE27672; Canary Islands, Tenerife, Radazul; 4 Oct. 1999; depth 20-30m; fertile. – MHNG INVE29810; Mediterranean, Spain, Mallorca, Cala Murada; 14 Aug. 2000; depth 2m; 16S sequence **AY787896**. – MHNG INVE32164; Mediterranean, Spain, Mallorca, Cala Murada; 30 Jul. 2001, depth 1 m. – MHNG INVE39448; Mediterranean, port of Monaco, artificial cave; 6 Jul. 2001; depth 9m. – MHNG INVE49719; Mediterranean, France, Marseille, Impériaux de Terre; 14 Jun. 2004; on rock; male; 16S sequence **AM991307**. – MHNG INVE49718; Mediterranean, France, Marseille, Grand Conglu; depth 3m; 16 Jun. 2004; on rock; female. – MHNG INVE49884; Italy, Naples; 23.12.1891; male and female stems. – MHNG INVE49885; Italy, Naples, Nisida; coll. ca. 1900, male. – MHNG INVE25958; Italy, Naples, coll. 1892. – Mediterranean, France, Banyuls-sur-Mer; 4m; male colony; 7 Nov. 1997; material not deposited; 16S sequence **AM991297**. – Mediterranean, Spain, Mallorca, Cala Murada; under rock overhang, depth 1-2m; 13 Jul. 2006, female; not deposited; 16S sequence identical to AY787896 – Mediterranean, Spain, Mallorca, Cala Murada; under rock overhang, depth 1-2m; 13 Jul. 2006, female; not deposited; 16S sequence identical to AY787896.

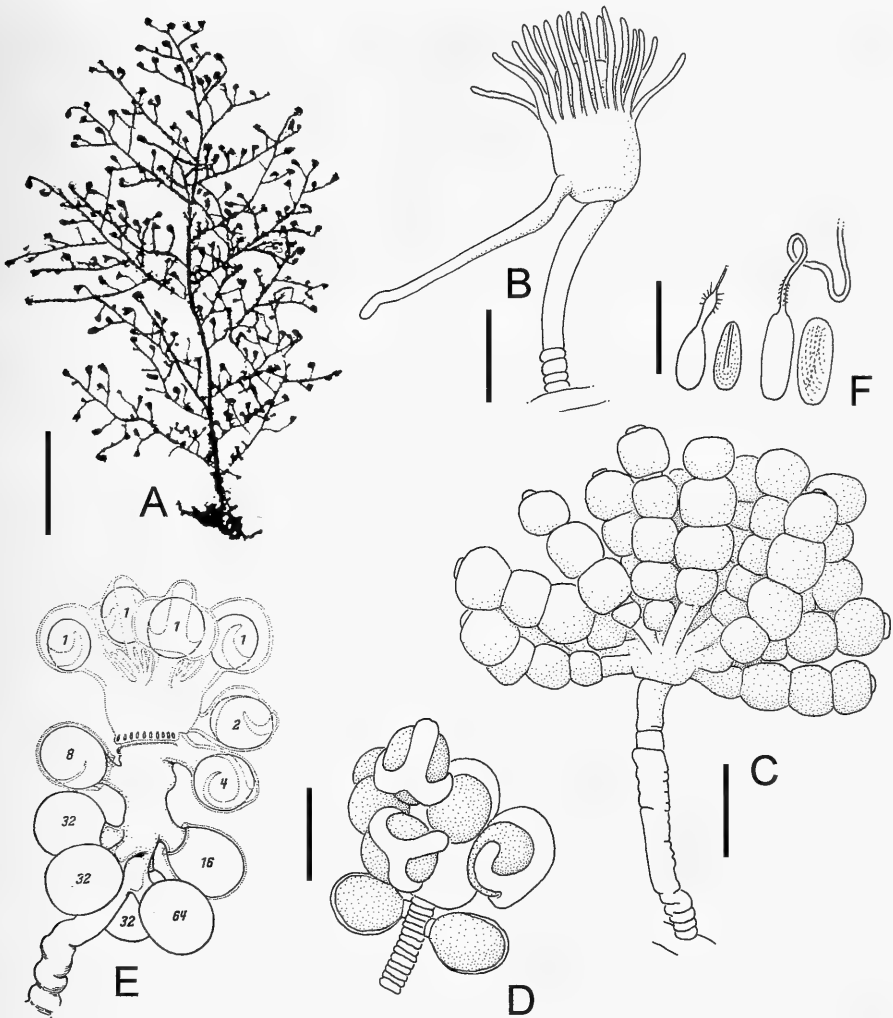


FIG. 9

Eudendrium racemosum (Cavolini, 1785), after preserved Mediterranean material. (A) Colony silhouette, scale bar 10 mm. (B) Hydranth with basal nematophore, scale bar 0.5 mm. (C) Male blastostyle, scale bar 0.5 mm. (D) Gonozooid with female sporosacs, note bifid spadix, scale bar 0.5 mm. (E) Schema of developmental stages on female blastostyle, the numbers indicate the number of nuclei during the embryonic development; figure modified after Mergner (1957). At the top, the eggs are held by the spadices, they are not yet fertilized. Fertilization has taken place in the eggs below, starting with the two nuclei stage to the 64 nuclei stage. Through the consecutive growth of the blastostyle the embryos come to lie more proximally and are ultimately attached to the pedicel. They are enveloped by a periderm membrane. (F) Nematocysts as pairs of discharged and native capsule: microbasic euryteles and basitrichous isorhizas.

DIAGNOSIS: Large colonies, mostly monosiphonic, some hydranths with cnidophores; blastostyles reduced; spadix of female gonophore branched; complementary nematocysts are isorhizas.

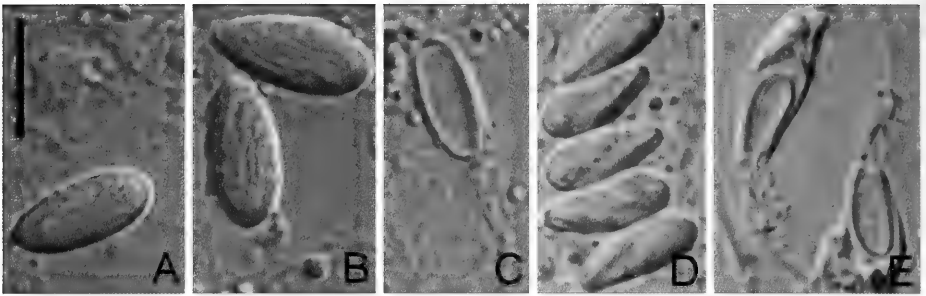


FIG. 10

Eudendrium racemosum (Cavolini, 1785), native nematocysts, scale bar 10 μm . (A-B) Undischarged isorhizas. (C) Discharged isorhiza. (D) Microbasic euryteles. (E) Discharged euryteles.

DESCRIPTION: Colonies much branched, often quite regular, bushy to tree-like. Stems usually monosiphonic, large colonies can be somewhat polysiphonic. Perisarc annulation of variable extent, intermittent with smooth regions. Hydranths typical for genus, 25-34 tentacles, frequently with tentacle-like process from lower part of hydranth body (cnidophore), length of cnidophore 1-3 times the size of hydranth, thicker than tentacles. Nematocysts on tentacles present in rings along entire length but density decreasing towards proximal, capsules erect and tentacle surface thus spiny. At lower fifth of hydranth body basal groove with origin of perisarc, perisarc here filmy and very thin (only visible at high magnifications). Above groove usually a concentration of mastigophores. Colonies dioecious.

Male gonophores develop on reduced hydranths, may have initially small tentacles, later atrophied; mature male sporosacs in a dense tuft at ending of a branch, each gonophore with 3-4 chambers, sometime terminal button, without dense nematocyst cluster.

Female gonophores develop on reduced (1/3 size) hydranths that are later completely atrophied. Gonophores typical for genus but spadix of younger gonophores bifid, may be lost in mature gonophores. Fertilized eggs encapsulated and attached to perisarc of blastostyle pedicels.

Nematocysts: microbasic euryteles on tentacles and atrichous or basitrichous isorhizas concentrated above basal groove.

Polyps whitish to light orange-pink, eggs in gonophores dark orange-red, perisarc brown.

DIMENSIONS: Stems 2-12 cm high, colonies from deeper waters up to 25 cm (Motz-Kossowska, 1905). Hydranths 0.5-1 mm, nematophore length 0.4-0.6 mm, hydranth pedicel diameter about 0.15 mm, diameter of stem at base 0.33-0.50 mm. Nematocysts: isorhizas (8-9) \times (3.5) μm ; microbasic euryteles (7-8) \times (2.5-3.5) μm .

BIOLOGY: In the Mediterranean, *E. racemosum* occurs rather abundantly in the first few metres, but it may be found in deeper waters up to 125 m depth (Motz-Kossowska, 1905; Boero & Fresi, 1986; Marqués *et al.*, 2000b; Peña Cantero & García

Carrascosa, 2002). It grows on rocks, concretions, barnacles, mussels, gorgonians, and algae. It is present throughout the year but is rare from December to February when it likely overwinters as a stolonal system. Fertile animals can be found from March to December, the main reproductive season seems to be during the summer.

More ecological data are given in Palombi (1940), Gili & Ros (1985), Barange *et al.* (1987), Sommer (1992), Azzini *et al.* (2003). Aspects of its feeding behaviour and ecology are described in Barange (1988), Barange, & Gili (1988), and Puce *et al.* (2002).

OTHER DATA: Details of the histology, gametogenesis, and development are given in Weismann (1883), Ishikawa (1887), Neppi (1917), Mergner (1957), Hanisch (1970), Sommer (1990). The egg maturation is also shown in Fig. 9E. Regeneration was studied by Billard (1904). Predation and the use of its nematocysts by nudibranch gastropods are described by Martin (2003), Martin & Walther (2002, 2003).

DISTRIBUTION: In the Mediterranean, this is a very common and easily obtainable hydroid. It occurs in the entire Mediterranean, this along the European, Asian and African shores (see references in Marques *et al.*, 2000b; Peña Cantero & García Carrascosa, 2002). It also occurs in Mediterranean lagoons (Morri, 1981). In the Atlantic, it is quite rare. Its northernmost records are from Brittany (Castric-Fey *et al.*, 2001; this study). It is present along the Iberian Peninsula (Medel & Lopez Gonzalez, 1996), the Canaries (this study), and western Africa (Leloup, 1940; Picard, 1951a; Buchanan, 1957; Bouillon *et al.*, 1995). In the Indian- and Pacific Ocean it has been found in the Seychelles, (Millard & Bouillon, 1973), tropical Australia (Watson, 1985), Vietnam (Leloup, 1937), Indonesia (Puce *et al.*, 2006), and Japan (Yamada 1954, Hirohito, 1988). The Japanese samples had strongly polysiphonic colonies, lacked nematophores and its nematocysts were not examined. As suspected by Hirohito (1988), I think that the Japanese *E. racemosum* belongs to a separate, unnamed species. Type locality: Mediterranean, Gulf of Naples, Cave of Gajola, Nisita Island (now Nisida) and Vico Equano (now Vico Equense) (Cavolini, 1785).

REMARKS: The name *Eudendrium racemosum* is here attributed to Cavolini (1785), but one might argue that Cavolini did not use a correct binomial nomenclature. Although he used indeed the Italian name for the genus (*Sertulara*), it was clearly used in a binomial context in the sense of Linnaeus. He treats several recognizable hydroids which he either assigned to *Sertulara* or to *Tubulara*, thus adopting clearly the system of Linnaeus.

Eudendrium racemosum mucronatum Billard, 1926, a species originally described from the Suez Canal, does not belong to *E. racemosum*. Marques *et al.* (2000b) re-examined the type specimen and also the other material of Billard. They found that part of the original material probably belongs to *E. carneum*, but the holotype represents likely a valid species neither referable to *E. racemosum* nor *E. carneum*. It should thus be used as *Eudendrium mucronatum* Billard, 1926.

Eudendrium racemosum is one of most common and conspicuous hydroids of the Mediterranean. It is also relatively easy and reliable to identify due to its isorhiza capsule, the nematophores, and the branched spadix.

***Eudendrium carneum* Clarke, 1882**

Fig. 11

Eudendrium carneum Clarke, 1882: 137, pl. 7 figs 10-17. – Fraser, 1944: 64, pl. 8 fig. 36. – Vervoort, 1968: 8. – Millard, 1975: 82, fig. 28. – Watson, 1985: 202, figs. 59-62. – Wedler & Larson, 1986: 84, fig. 6Ba-b. – Calder, 1988: 43, figs 33-35. – Bavestrello & Piraino, 1991: 197, figs 1a-c. – Marinopoulos, 1992: 57, fig. 2.3. – Marques *et al.*, 2000a: 90, figs 35-41. – Marques *et al.*, 2000b: 206.

Eudendrium cunninghami Kirkpatrick, 1910: 127, pl. 7 figs 1-3. – Vannucci, 1954: 101, synonym. – Marques *et al.*, 2000b: 207, synonym.

Eudendrium ramosum. – Weill, 1934b: 388, figs 237. [not *Eudendrium ramosum* (Linnaeus, 1758)]

MATERIAL EXAMINED: MHNG INVE35472; Honduras, Utila, 16.0687°N 86.9555°W, depth 20 m; 11 Feb. 2004; fertile female; DNA extracted, 16S DNA sequence accession number **AM991305**. – MHNG INVE39470; France, Corsica, Ajaccio; 4 July 1950; male colony. – ZMUC, without number, as *E. ramosum*; USA, Cape Cod, Lagoon Pond Bridge; 17 July 1964; fertile male. – Lebanon; depth 12m; July 2003; male colony; personal collection of Dr S. Puce. – Lebanon, Beirut Harbour; depth 3m; Sept. 2002; female colony; personal collection of Dr S. Puce.

DIAGNOSIS: Large, polysiphonic colonies, complementary nematocyst a large haploneme (anisorhiza); male blastostyles completely atrophied; female blastostyle completely atrophied or with some few and small tentacle rudiments; female sporosacs with bifid spadix, during later development reduced but forming a periderm membrane holding encapsulated embryos.

DESCRIPTION (Calder, 1988; Bavestrello & Piraino, 1991; own data): Colony extensively branched and irregularly bushy, arising from a creeping mass of stolons. Basal part and sometimes also major branches polysiphonic. Perisarc thick, brown in older parts of colony, thinner and paler towards extremities, annulated or wrinkled at bases of branches and hydranth pedicels, with occasional annulations elsewhere but mostly smooth, terminating almost imperceptibly at groove around hydranth base. Hydranths with large hypostome, up to 32 tentacles.

Male gonophores (>10) in a tuft at end of pedicel, without vestiges of hydranth, gonophores with 3-4 chambers each, distal end of gonophore with scattered nematocysts.

Female gonophores (4-10) on almost entirely atrophied hydranths, sometimes transiently with a few reduced tentacles; spadix bifid, curving over egg. After fertilization the spadix is reduced, but before this the spadix secretes a covering of periderm which then holds the encapsulated embryos in a dense clusters on the blastostyle pedicels; perisarc membranes often moulded into shape of enlarged spadix, with two openings, but often also irregular (Fig. 11E).

Nematocysts: microbasic euryteles on tentacles and in other tissues; anisorhizas with shaft tapering only towards its distal end, thus appearing as isorhiza, scattered on hydranth base, hypostome, tips of male gonophores.

Colours (Clarke, 1882): hydranths and gonophores red.

DIMENSIONS: Colonies of variable height reaching up to 24 cm (Bavestrello & Piraino, 1991), more commonly around 10 cm. Hydranths 0.4-0.8 mm total height and 0.5-0.6 mm wide (Bavestrello & Piraino, 1991). Male gonophores 0.5-0.6 mm long, maximal diameter 0.2 mm; embryo capsules (0.25-0.3)x(0.4)mm. Haploneme (21-26)x(9-11) μ m, $r=2.1-2.6$; microbasic eurytele (7.5-9)x(3.5-4) μ m $r=2.3-2.5$. Non-

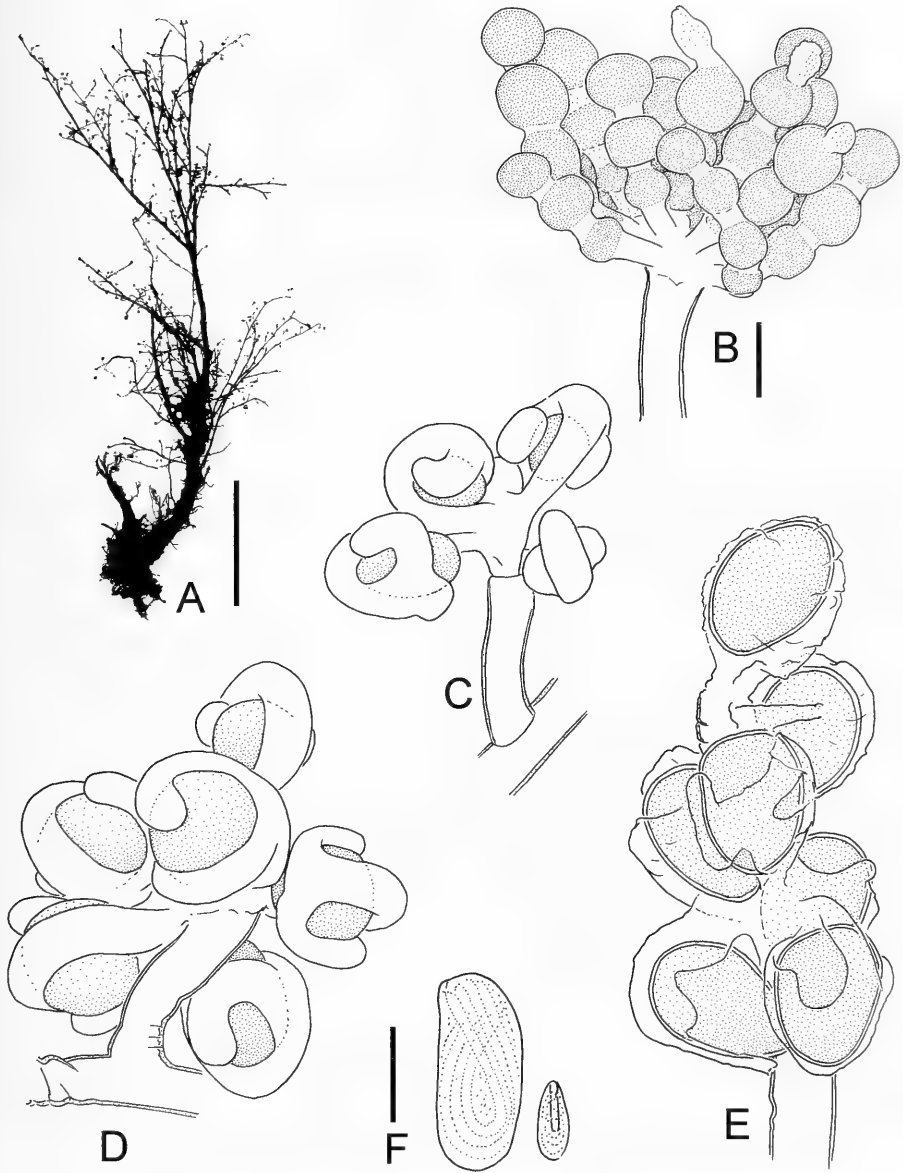


FIG. 11

Eudendrium carneum Clarke, 1882; after preserved Mediterranean material. (A) Colony silhouette, scale bar 2 cm. (B) Male blastostyle, some terminal chambers have spent their gametes, scale bar 0.2 mm. (C) Young female blastostyle, same scale as B. (D) More advanced female blastostyle, note branched spadices, same scale as B. (E) Encapsulated embryos attached to pedicel of former blastostyle, note fenestrated periderm membranes that hold capsules, same scale as B. (F) Nematocysts: haploneme and microbasic eurytele. Scale bar 10 μ m.

European populations have quite similar values (Millard, 1975; Watson, 1985; Calder, 1988).

BIOLOGY: This species often occurs on ship hulls and is thus potentially easily introduced to other regions (Millard, 1975). In the Mediterranean, this is not a frequent species, but along the American coast it can occur in dense stands (Clarke, 1882; Calder, 1988). It is usually found in depths from 0-20 m (Marques *et al.*, 2000b), but prefers shady environments (Bavestrello & Piraino, 1991). Fertile colonies have been found in the Mediterranean from July to December (Marques *et al.*, 2000b; this study). Detailed ecological studies are provided by McDougall (1943), Wedler (1975), Calder (1976, 1990). Summers (1972, as *E. ramosum*) examined the ultrastructure of the spermatids.

DISTRIBUTION: Mediterranean, perhaps introduced by human activity (Picard, 1958; Bavestrello & Piraino, 1991; Marques *et al.*, 2000b), western Atlantic from New England to Florida (Fraser, 1944; Marques *et al.*, 2000b), tropical eastern Atlantic (Vervoort, 1968, Wedler, 1975; Wedler & Larson, 1986), Brazil (Vannucci, 1954), French Guyana (Bouillon *et al.*, 1995), Island of St Helena (Kirkpatrick, 1910), southern Africa (Millard, 1959; 1975); western Australia (Watson, 1985), California to tropical eastern Pacific (Fraser, 1939; 1948), perhaps also Korea (Park, 1991). Type locality: USA, Virginia, Fort Wool, in the entrance to Hampton Roads (Clarke, 1882).

REMARKS: Although *E. carneum* has some similarities with *E. racemosum* (large colonies, bifid spadix, reduced blastostyles), it can be distinguished rather reliably: its haplonemes are much larger, mature colonies are always polysiphonic, and the embryos are held by periderm membranes.

The haplonemes have been variably identified as isorhizas or anisorhizas. Watson (1985) showed that these capsules have a very long thread (1 mm) which tapers only in the very terminal region. It is thus easily mistaken for an isorhiza. The differences between anisorhiza and isorhiza are anyway gradual and often not so clear. Using the more inclusive term haploneme is thus preferable.

Infertile or male colonies can be mistaken for *E. glomeratum* if no discharged nematocysts can be examined. However, *E. carneum* lacks the characteristic nematocyst buttons of *E. glomeratum*.

Eudendrium racemosum mucronatum Billard, 1926, a species originally described from the Suez Canal, does not belong to *E. racemosum*. Marques *et al.* (2000b) re-examined the type specimen and also the other material of Billard. They found that part of the original material probably belongs to *E. carneum*, but the holotype likely represents a valid species neither referable to *E. racemosum* nor *E. carneum*. It should thus be used as *Eudendrium mucronatum* Billard, 1926.

Eudendrium ramosum (Linnaeus, 1758)

Figs 12-14

Tubularia cylindris ramosis Ellis, 1755: 31, pl. 16a, pl. 17A, a.

Tubularia ramosa Linnaeus, 1758: 804.

Tubularia trichoides Pallas, 1766: 84. – Hincks, 1868: 82, synonym.

Eudendrium insigne Hincks, 1861: 160. **new synonym**

Eudendrium insigne. – Hincks, 1868: 86, pl. 14 fig. 3. – Allman, 1872: 337, pl. 14 figs 4-6.

Eudendrium ramosum. – Hincks, 1868: 82, pl. 13. – Allman, 1872: 332, pl. 13. – Fraser, 1937: 42, pl. 7 fig. 32. – Fraser, 1944: 72, pl. 12 fig. 48. – Yamada, 1954: 27. – Hamond, 1957:

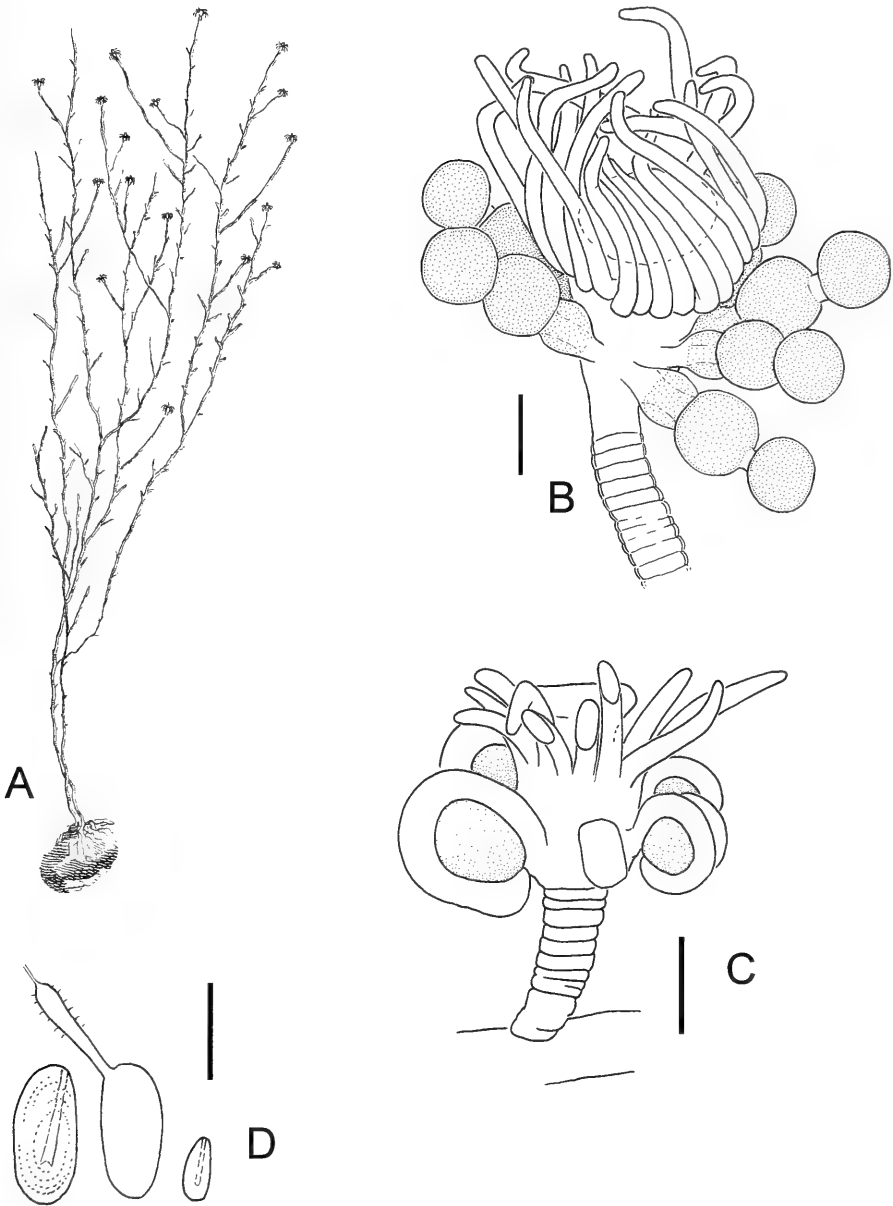


FIG. 12

Eudendrium ramosum (Linnaeus, 1758). (A) Colony, from Ellis (1755). (B) Male gonozoid, scale bar 0.2 mm, after preserved material from the Mediterranean. (C) Female gonozoid, scale bar 0.2 mm, after preserved material from the Mediterranean. (D) Nematocysts of Atlantic material: large microbasic eurytele, same discharged, small tentacular microbasic eurytele.

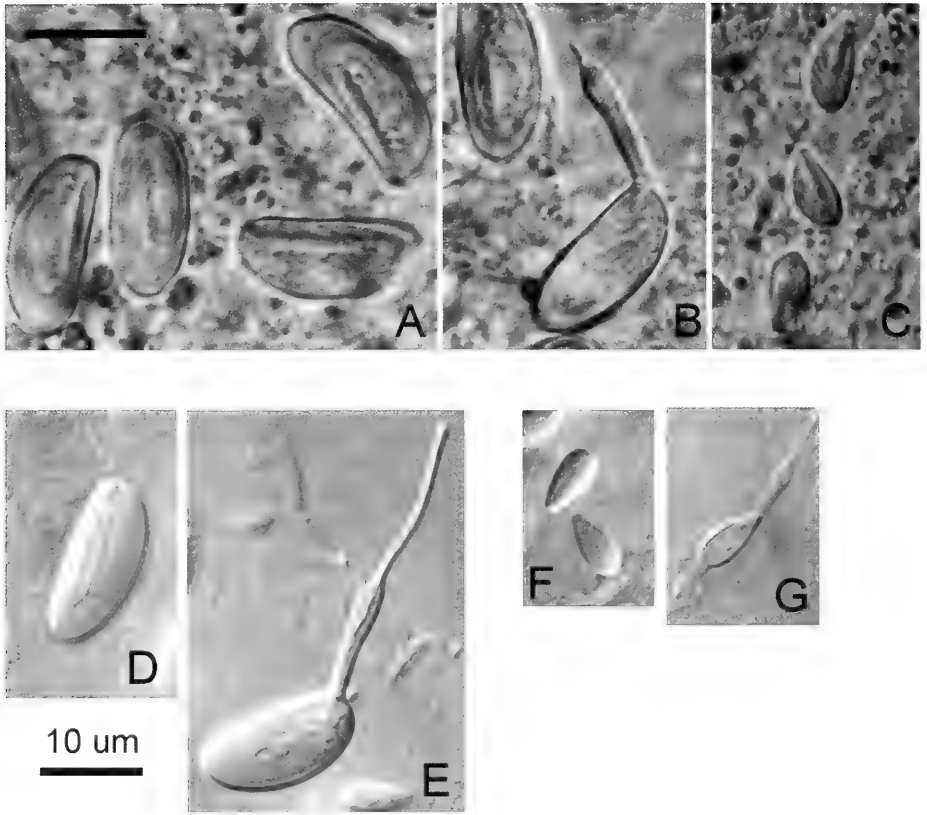


FIG. 13

(A-C) *Eudendrium ramosum* (Linnaeus, 1758); native nematocysts of Mediterranean material, scale bar 10 μm . (A) Large microbasic eurytele. (B) Same discharged. (C) Small microbasic eurytele.

(D-G) Topotype material of *Eudendrium insigne*; nematocysts of alcohol preserved material, scale bar 10 μm . (A) Intact large microbasic eurytele. (B) Same discharged. (C) Small microbasic euryteles. (D) Same discharged.

300. – Naumov, 1969: 266, fig. 135. – Millard & Bouillon, 1973: 32, fig. 31A-D. – Millard & Bouillon, 1974: 19, fig. 3A-D. – Millard, 1975: 85, fig. 31A-D. – Hirohito, 1988: 87, figs 30d-e, 31a-c, pl. 2 fig. C. – Ramil & Vervoort, 1992: 20. – Marinopoulos, 1992: 59, fig. 5. – Marques *et al.*, 2000a: 104, figs 75-78. – Marques *et al.*, 2000b: 204. – Schuchert, 2001: 32, fig. 20. – Peña Cantero & García Carrascosa, 2002: 37, fig. 7a-c.

Eudendrium elsae-oswaldae Stechow, 1921: 252. – Stechow, 1923: 81, fig. G. **new synonym** *Eudendrium elsaeoswaldae*. – Marques *et al.*, 2000a: 94, figs 47-49. – in part Marques *et al.*, 2000b: 209.

? *Eudendrium ramosum*. – Watson, 1985: 191, figs 29-34.

not *Eudendrium ramosum*. – van Beneden, 1844. [= *Bougainvillia muscus* (Allman, 1863)]

not *Eudendrium ramosum*. – Motz-Kossowska, 1905: 54, pl. 3 fig. 16. [= *Eudendrium glomeratum* Picard, 1952]

not *Eudendrium ramosum*. – Weill, 1934b: 388, figs 237. [= *Eudendrium carneum* Clarke, 1882]

not *Eudendrium ramosum*. – Kramp, 1926: 241. [= *Myrionema multicornis* (Allman, 1876)]

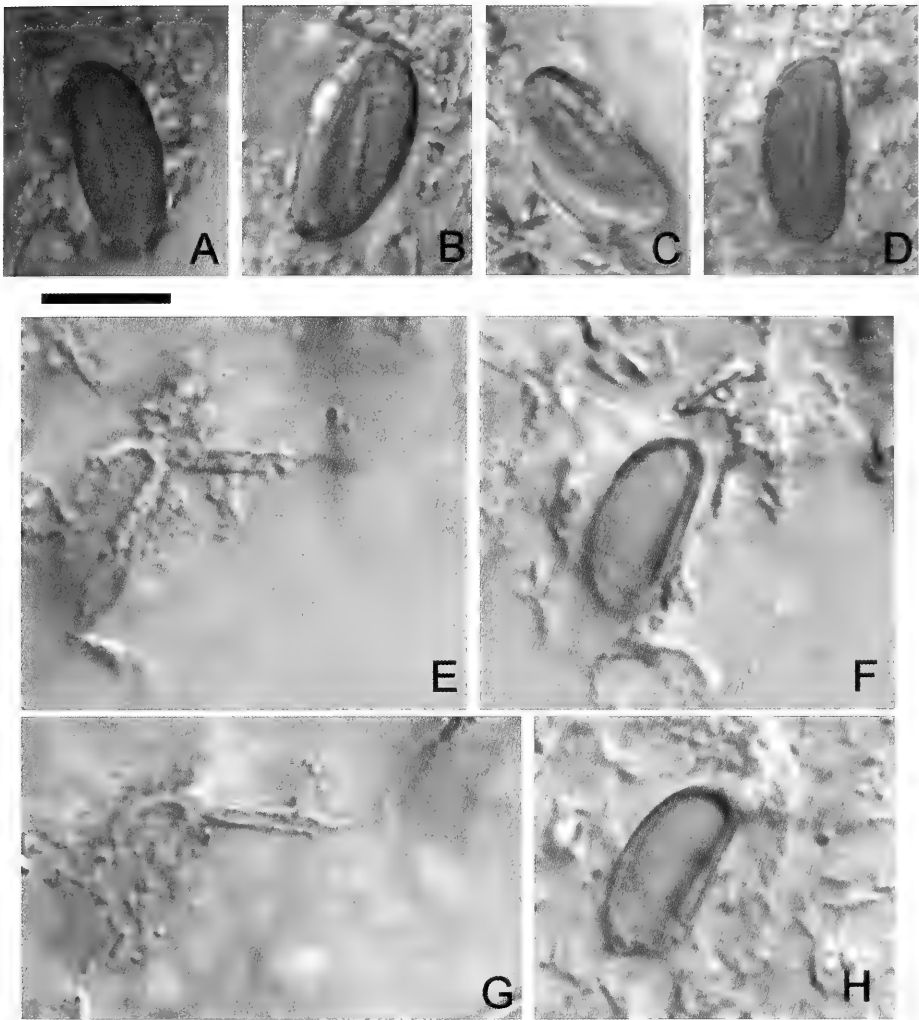


FIG. 14

Complementary nematocysts of the syntype material of *Eudendrium elsaeoswaldae*, ZSM no 20040383, scale bar 10 μm . (A-D) Intact large microbasal euryteles. (E-H) Two discharged large microbasal euryteles. The image-pairs E+F and G+H depict each the same capsule, but in different focusing planes, this in order to better visualize the shaft (E, G) or the capsule (F, H).

E. RAMOSUM MATERIAL EXAMINED: MHNG INVE25956; Italy, Naples, 23 Dec. 1891; female. – MHNG INVE25957; Italy, Naples, coll. 1892, infertile. – MHNG INVE3945; France, Banyuls-sur-Mer, Cap Abeille; 30 Oct. 1947. – BELUM Md354; Northern Ireland, Strangford Lough, NW Limestone Rock; 54.421° N 5.611°W; depth 28m; 20 May 1982; female. – BELUM Md105; Northern Ireland, Strangford Lough, Bay to N of Audley's Point; 54.386°N 5568°W; depth 12m; 25 April 1976; male. – BELUM, without registration number, field number 900620/01; loc. Ireland; 20 June 1990; male and female colonies. – BELUM, without registration number, field number 910328/01; Scotland, Sound of Mull, Hispania wreck, depth 18m,

28 march 1991, male. – ZSM, CT356; Plymouth Zoological Station, coll. 1909; 12cm colony. – Italy, Portofino, Sept. 2004, depth 15-20m; males; in pers. collection of S. Puce (as *E. moulouensis*). – Italy, Sardinia, Oct. 2005, depth 24m; females; in pers. collection. S. Puce (as *E. moulouensis*).

E. INSIGNE MATERIAL EXAMINED: MHNG INVE54560, topotype material for *Eudendrium insigne*; England, Torquay, Hope's Nose, rock pool at low water level; 16 June 2007; fertile female; part used to extract DNA, **AM991293**. – IRSNB, Ig 11365, as *Eudendrium insigne*; Germany, Helgoland, leg. Leloup; female colony of 16 mm. – BELUM Md615; as *E. insigne*; Northern Ireland, Strangford Lough Narrows, Rue Point; 54.365°N 5.541°W; depth 25m; 11 Aug. 1983; male. – BELUM Md614; as *E. insigne*; Northern Ireland; Strangford Lough Narrows, W of Rue Point; 54.365°N 5.542°W; depth 7m; 2 Aug. 1980; female.

E. ELSAEOSWALDAE MATERIAL EXAMINED: Syntype material *Eudendrium elsaeoswaldae*, ZSM no 20040383, alcohol and slide preparations, Naples, Posilippo, 20 m.

DIAGNOSIS: Colonies monosiphonic or exceptionally with few complementary tubes near base; complementary nematocysts large microbasic euryteles with rather small spines, dispersed on hydranth body. Female and male sporosacs developing on unreduced hydranths, in later development sometimes partially reduced.

DESCRIPTION: Colonies usually much branched, intertidal colonies can be small, colony shape slender, elongate with a tendency to pinnate growth (Atlantic populations); stem usually monosiphonic or occasionally only slightly polysiphonic (2-5 tubes) very close to base. Hydranths with 20-30 tentacles, large euryteles dispersed on hydranth body, not clustered along basal groove.

Male sporosacs on non-reduced hydranths, up to five per hydranth, two-chambered; in advanced stages tentacles sometimes atrophied.

Female gonophores develop on normal or slightly smaller hydranths with normal number of tentacles, up to seven gonophores per gonozooid, spadix simple, long; gonozooid during later development not or only tentacles atrophied. Encapsulated embryos attached along pedicel.

Nematocysts: small tentacular microbasic euryteles; large complementary microbasic euryteles, shaft in intact capsule spanning 2/3 to 4/5 of capsule length, spines on discharged shaft small.

Colours (Allman, 1872): Hydranths reddish; male sporosacs with red spadix; female gonophores orange-red.

DIMENSIONS: Shoots up to 15 cm high, width usually much less (2-5 cm); hydranth 0.7-0.8 mm high, diameter 0.4-0.5 mm, pedicel 0.17-0.22 mm. Large microbasic euryteles: (13-19.5) × (6.5-9) μm, $r=1.9-2.3$; small microbasic euryteles (6.5-8.3) × (2.5-4.3) μm $r=2.0-2.5$.

VARIATION: The colonies are stout in shallow water and more slender in deeper waters (Boero & Fresi, 1986). Some Mediterranean colonies had hydranths with distinct bright bodies (about 30 μm) in their gastrodermis, resembling large cells densely filled with spherical bodies. They did not stain with iodine and are thus unlikely to be zoxanthellae. The bodies were seen in the hydranth body, pedicels, and rarely in the tentacles. It remained unclear whether they are formation of the hydroid or exogenous, e. g. parasitic protists.

BIOLOGY: The colonies grow on a large variety of solid substrata. Along the European coasts occurring usually in depths of few metres to about 80 m (Russell,

1957; Teissier, 1965; Rees & Rowe, 1969; Christiansen, 1972; Peña Cantero & García Carrascosa, 2002). The fertility period in the Atlantic is at least from March to November (Allman, 1872; Philbert, 1935; Billard, 1927; Russell, 1957; Teissier, 1965; Christiansen, 1972). In the Mediterranean, it is present all year round except June, it is more abundant from October to March; the reproductive period is July to February (Boero & Fresi, 1986).

DISTRIBUTION: Reportedly circumglobal in warm or temperate waters, also in the Arctic, but most of the records are doubtful (Marques *et al.*, 2000b). The known distribution includes the Mediterranean and, all European coasts from the Arctic to Africa; absent from the Baltic Sea? (Billard, 1927; Leloup, 1947; Rees, 1952; Picard, 1955; Buchanan, 1956; Hamond, 1957; Russell, 1957; Christiansen, 1972; Morri *et al.*, 1991; Marques *et al.*, 2000a, 2000b; Schuchert, 2001; Peña Cantero & García Carrascosa, 2002; Vervoort, 2006). Type locality: North Sea, Whitstable, Kent, England (Boero & Cornelius, 1987).

REMARKS: *Eudendrium ramosum* is difficult to separate from a number of other species, notably also *E. merulum*, *E. arbusculum*, and *E. rameum* (Marques *et al.*, 2000b). When identifying *E. ramosum*, emphasis must be laid on the monosiphonic or only lightly fascicled stem base, the dispersed large euryteles on the hydranth body, and the non reduced gonozooids. The typical colony form was already well depicted and described by Ellis (1755) (see Fig. 12). These figures served Linnaeus to give it its present name (hence the figures can be considered as depicting the type specimen).

The diagnosis of *Eudendrium insigne* Hincks, 1861 is (after Hincks, 1868): "Colonies 10-20 mm with few branches, monosiphonic, perisarc annulated throughout, hydranths yellowish-red, male and female gonophores on intact hydranths."

Eudendrium insigne is thus also not readily separable from other *Eudendrium* species, particularly *E. ramosum*, primarily because so far no information on the nematocysts is available. Searches for type material of *E. insigne* in several museums yielded nothing. I therefore tried to collect the species again at its type locality, given by Hincks as "intertidal, on sponge, Hope's Nose". Hope's Nose is a rocky promontory east of Torquay (Devon, England). When visited in 2007, there were only few suitable places in the intertidal zone where sponges and hydroids could grow, except for a set of three small but deep rock pools at low-water level on a quite flat rock platform. At least two of them harboured dense populations of hydroids, mainly an *Aglaophenia* species, but also *Coryne muscoides* and Campanulariidae. In one of the pools, underneath an overhang, several stems of a *Eudendrium* associated with a sponge were found. Although we have no idea on how long intertidal rock pools exist over time, their depth (40 cm) suggests that they could have been present even in Hincks's time and it is very likely that he collected *E. insigne* from these three rock pools. The recently collected *Eudendrium* stems (MHNG INVE54560) are rather small (up to 10 mm), are branched a few times, have pale orange-red hydranths, the perisarc is extensively annulated but some smooth stretches are present, and the female sporosacs are on intact or almost intact hydranths. This material thus matches Hincks's description almost perfectly and it can be assigned to *E. insigne* without hesitation. The nematocysts proved to be identical to those seen in *E. ramosum* (Fig. 13). Except for the stem

heights, there is thus nothing that distinguishes *E. insigne* from *E. ramosum*. The stem size and the more pronounced annulation, however, can easily be attributed to its origin in the intertidal, wave-exposed region. *Eudendrium insigne* Hincks, 1861 must therefore be regarded as conspecific with *Eudendrium ramosum* (Linnaeus, 1758) as defined here.

Eudendrium elseoswaldae Stechow, 1921 from the region of Naples was characterized by Stechow (1923) by its long, monosiphonic stems (up to 23 cm) and the elongated hydranths without perisarc groove. Stechow (1923), who did not have fertile material, admitted that his material closely resembled *Eudendrium ramosum* depicted in Hincks (1868: pl. 13). Later authors (e. g. Picard, 1958; Marinopoulos, 1992; Boero & Bouillon, 1993) implicitly considered the species either a synonym or doubtful as they did not include it in their lists of the Mediterranean *Eudendrium* species. Marques *et al.* (2000a, 2000b) redescribed the species based on type and non-material and considered it as a distinct species characterized by the presence of large atrichous isorhizas. The type material of *Eudendrium elsaeoswaldae* (ZSM number 20040383) was also re-examined for this study. Although the colonies are rather large (up to 15 cm), there is nothing that distinguishes this material from *Eudendrium ramosum* *sensu* Hincks. The polyps are not all particularly elongated and those that are so appear artificially stretched. A perisarc groove is present very low on the hydranth body. An examination of the nematocysts (slide material and alcohol preserved material) gave deviant results from those reported by Marques *et al.* (2000b). The complementary capsules are clearly microbasic euryteles (Fig. 14A-H) that are indistinguishable from those of *E. ramosum*. There is thus nothing that distinguishes the type material of *Eudendrium elsaeoswaldae* from *Eudendrium ramosum* *auct.* *Eudendrium elsaeoswaldae* Stechow, 1921 is therefore here synonymized with *Eudendrium ramosum* (Linnaeus, 1758). As Marques *et al.* (2000b) had also other material they considered to belong to *E. elseoswaldae*, they have perhaps based their nematocyst observations on this non-type material.

Perigonimus multicornis Allman, 1876 was attributed to *Eudendrium ramosum* by Kramp (1926), but a re-examination of the type material showed that it has macrobasic euryteles and belongs to the genus *Myrionema*.

Watson (1985) found cnidophores in her Australian material identified as *E. ramosum*. Nematophores have never been found in European *E. ramosum* and Watson's material belongs perhaps to a new species.

Eudendrium rameum (Pallas, 1766)

Fig. 15

Tubularia ramea Pallas, 1766: 83.

Eudendrium rameum. – Hincks, 1868: 80, frontispiece. – Allman, 1872: 334. – Fraser, 1937: 42, pl. 7 fig. 31. – Fraser, 1944: 71, pl. 11 fig. 47. – Yamada, 1954: 7, fig. 6. – Naumov, 1969: 264, fig. 133. – Millard, 1977: 3. – Marinopoulos, 1992: 58 fig. 1.6. – Marques *et al.*, 2000a: 102, figs 71-74. – Marques *et al.*, 2000b: 204. – Schuchert, 2001: 31, fig. 19A-B – Peña Cantero & García Carrascosa 2002: 35, fig. 7d-e.

Eudendrium planum Bonnevie, 1898a: 483, pl. 26 figs 28-30. **news synonym**
not *Eudendrium planum*. – Kramp, 1939: 516. – Calder & Vervoort, 1998: 9, fig. 2a-b. – Kramp, 1932a: 20, figs 9-11, 31. – Schuchert, 2001: 30, fig. 18A-B.

Eudendrium stratum Bonnevie, 1898a: 483, pl. 26 figs 22-24. **news synonym**
not *Eudendrium rameum*. – Hirohito, 1988: 84, fig. 30a-c.

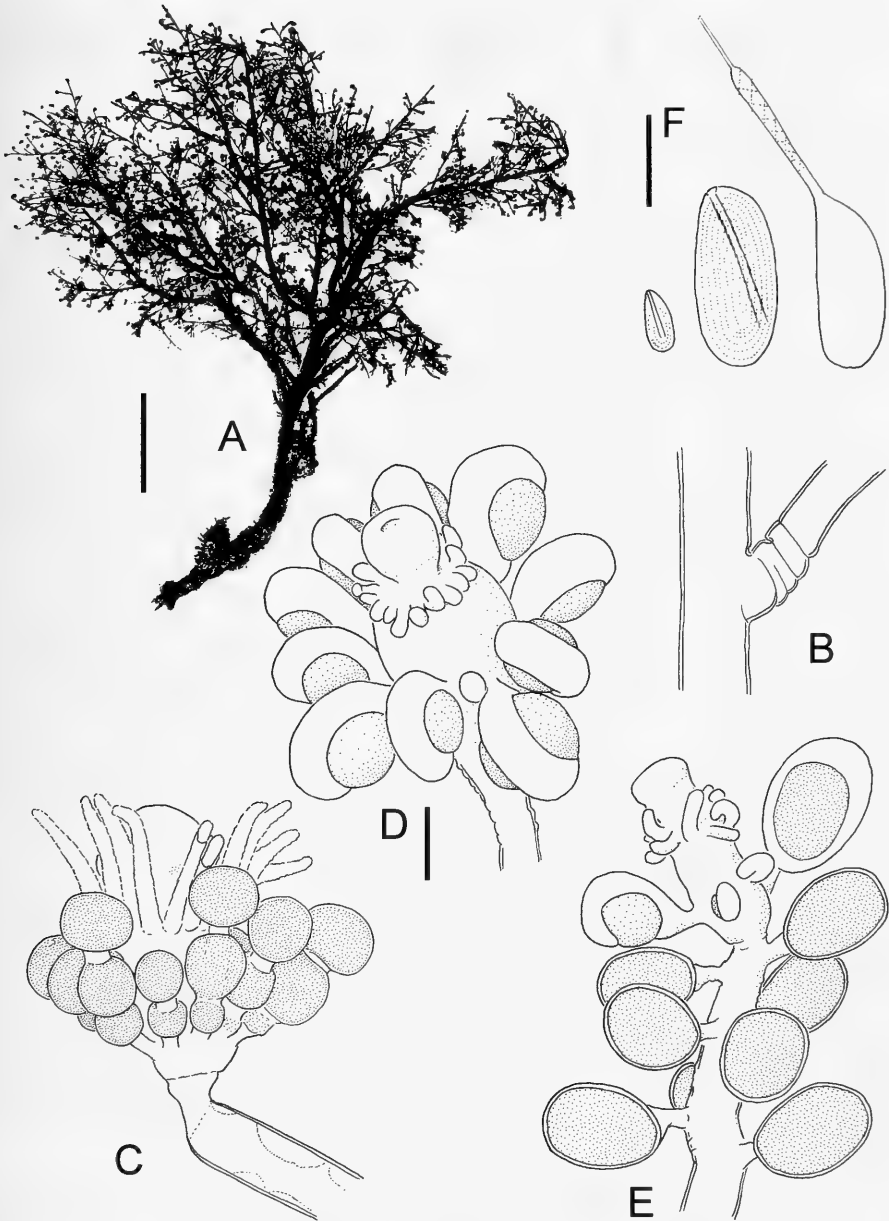


FIG. 15

Eudendrium rameum (Pallas, 1766), after preserved material from Norway (Trondheim Fjord). (A) Colony silhouette, scale bar 2 cm. (B) Base of side branch with annulation, same scale as D. (C) Hydranth with male gonophores, same scale as D. (D) Female gonophores on slightly reduced hydranth (tentacles shortened), scale bar 0.2 mm. (E) Blastostyle with eggs on partially reduced hydranth and encapsulated embryos attached to pedicel, same scale as D. (F) Nematocysts: small microbasic eurytele, large microbasic eurytele, same discharged, scale bar 10 μm .

TYPE MATERIAL EXAMINED: ZMO B1238, syntype colonies of *Eudendrium planum*, Zoological museum of Oslo; no locality or date; on label note that also *Lafoea serpens* and *Campanulina fastigata* Alder present. – ZMO B1239, type colony of *Eudendrium stratum*; no locality; fragments of polysiphonic colony, with male gonophores.

Other MATERIAL EXAMINED: MHNG INVE33539, BIOFAR station 726; The Faroes, 60.66°N 06.91°W, depth 400m; 29 Sept. 1990, infertile. – MHNG INVE33588, BIOFAR station 554; The Faroes, 61.93°N 6.49°W, depth 62m; 22 Sept. 1989, 2 infertile colonies. – MHNG INVE38221; Mediterranean, France, Marseille, Grotte de Figuiet; 24 April 1970; leg. H. Zibrowius; fertile female. – MHNG INVE49888; Italy, Naples; 21 Jan. 1892; infertile. – SMNH89692; Norway, SE to S off Bergen, 182–291m; collected ca. 1874; material mentioned in Jäderholm (1909); no hydranths or gonophores left. – ZSM, Stechow collection, Valdivia station 3, Aberdeen, Scotland, depth 79m, 57°26'N 1°28'W, det. E. Stechow, without gonophores. – ZSM, CT349, Material Bedot Nr. 69, det. E. Stechow, Cap Misano near Naples, 23 Jan. 1892, several colonies, max. 5cm, fertile male. – ZSM, slide 20000794, Naples, fragments of male and female colony. – ZMUC, without number; Norway, Trondheim Fjord, Vennes; depth 6.5m; 18 Sept. 1934; female and male colonies.

DIAGNOSIS: Colonies large, polysiphonic, usually tree-like with a distinct trunk, female on hydranth with hypostome, with variably developed tentacles, spadix simple; male gonophores on normal hydranth which can get somewhat reduced during maturation. Complementary nematocysts a microbasic eurytele, dispersed on hydranth body, shaft thin, in undischarged capsule spanning 4/5 or more of capsule.

DESCRIPTION: Colonies much branched, stem and branches polysiphonic, terminal branches simple. Colony form usually tree-like with a thick trunk. Hydrorhiza root-like, creeping. Perisarc thick, short stretches of annulation frequent, especially at bases of branches. Hydranths typical for genus, without nematocyst buttons or ring, 16–24 tentacles.

Male gonophores on normal, tentacle bearing hydranth which is not or only slightly reduced after maturation of the gonads, up to 12 gonophores per hydranth, in dense whorl around body of hydranth, with one to three chambers, without terminal nematocyst clusters.

Female gonophores (up to 16 per hydranth) develop on hydranths with a hypostome and with shortened tentacles, spadices simple, tentacles get variably reduced: Fertilized eggs loose spadix and get encapsulated in perisarc membrane and attached to pedicels of former blastostyle, the latter can resume growth.

Nematocysts: small microbasic euryteles predominantly on tentacles; large microbasic euryteles, shaft with fine spines, only slightly swollen and sometimes indistinguishable from mastigophores type, shaft in undischarged capsule long, spanning 4/5 to 1/1 of capsule length, discharged shaft about as long or slightly longer than capsule.

Colours: perisarc brown, hydranths pale.

DIMENSIONS: Colonies 4–20 cm, mostly below 12 cm; hydranths 0.5 mm diameter and total height 0.7–0.8 mm; diameter of hydranth pedicels 0.15–0.2 mm, diameter of basal stem tubes 0.23–0.26 mm. Small microbasic eurytele (7–9)×(3–5)μm, r= 1.8–2.5. Large microbasic eurytele (20–26)×(8–11)μm, r= 2.4–2.8.

BIOLOGY: Mostly recorded in depths from a few metres to about 100 m on hard bottoms (Christiansen, 1972). There are not enough data on the fertility periods available. Fertile colonies from the Mediterranean have been found in the months

January, April, and September (Marques *et al.*, 2000b; this study). For the North Sea, Hamond (1957) give a fertile period of November to March. In Norway, Christiansen (1972) observed sporosacs between June and October.

DISTRIBUTION: The species has been recorded in almost all oceans, but only identifications also using nematocyst morphology can be considered reliable. It is thus certainly present in the Mediterranean, along the European Atlantic coast, Greenland, Iceland (Marques *et al.*, 2000a and 2000b; Schuchert, 2001; Peña Cantero & García Carrascosa, 2002), and southern Indian Ocean (Millard, 1977). Type locality: Mediterranean (Pallas, 1766).

REMARKS: Pallas (1766) described *Eudendrium rameum* as a polysiphonic, tree-like colony which he qualified as common in the Mediterranean ("Locus: *Mare Mediterraneum, praecipue ubi Filigrana Planci abundat*"). The species as conceived today is not common in the Mediterranean and Pallas's diagnosis could either refer to *E. rameum*, *E. glomeratum*, or even *E. racemosum*. While earlier authors diagnosed this species mostly through its tree-like colony form, our current scope of the species relies additionally on the presence of dispersed large microbasic euryteles and on the unreduced or only moderately reduced blastostyles. However, Marques *et al.* (2000a) are right by qualifying this species and *E. ramosum* as confusing. Preliminary molecular data (Moura *et al.*, 2008 and Fig. 2) indicate that our current concept of *E. rameum* comprises several lineages and perhaps also several species.

The type specimens (2 colonies plus some fragments) of *Eudendrium planum* Bonnevie, 1898a were examined for this study. The stems are up to 6 cm high, strongly polysiphonic. The colonies are female, only encapsulated embryos attached to blastostyle pedicels are present. There are no gonophore stages with spadices. The arrangement is in no way particular. As nematocysts there are two types of microbasic euryteles, small almond-shaped (7-8)x(3) μ m (tentacular type) and large elongate oval ones sized (16-19)x(6-7) μ m, $r=2.5-3.2$. The shaft in the intact larger eurytele spans almost the whole length of the capsule. All these data match perfectly our current concept of *Eudendrium rameum*. *Eudendrium planum* should therefore be regarded as a synonym of the former species. Calder, & Vervoort (1998) and Schuchert (2001) also described nematocysts of tentatively identified *E. planum*. Both studies found macrobasic euryteles, meaning that these specimens are neither *E. planum* nor *E. rameum*. The specimen of *E. planum* described by Kramp (1939; Kara Sea; kept by ZMUC) has differently shaped complementary capsules (with pointed ends) without a visible shaft inside. Also this record is thus not *E. planum*, more likely it is an undescribed species.

Together with *E. planum*, Bonnevie (1898a) also described *Eudendrium stratum*. She characterized this species by the peculiar covering of the stem. The type specimen was re-examined for this study. It consists of several polysiphonic stem fragments. Male gonophores with 3 chambers are present on unreduced hydranths. The stem is covered by a soft tissue with a spongy, cellular structure containing no nematocysts. It is unclear what this covering is, but is very unlikely that it was produced by the hydroid and it must be foreign. The nematocysts of the hydroid appear identical to *E. planum*, though somewhat larger. The complementary capsules are likely heteronemes (none seen discharged) with a size of (20-22)x(9-10) μ m. The apparent shaft is

often not well visible, but when visible, it spans the entire length of the capsule, sometimes it is even somewhat curved. There are no traits visible in this material that would preclude its identification as *E. rameum* as defined here. *Eudendrium stratum* is therefore regarded as a synonym of *E. rameum*.

Eudendrium moulouyensis Marques, Peña Cantero & Vervoort, 2000 Figs 16-19

? *Eudendrium hargitti*. – Castric & Michel, 1982: 82, fig. [not *Myrionema hargitti* (Congdon, 1906)]

Eudendrium moulouyensis Marques, Peña Cantero & Vervoort, 2000: 200, fig. 1. – Peña Cantero & García Carrascosa 2002: 31. – Puce *et al.*, 2005: 202, fig. 1e, 2l-m. – De Vito *et al.*, 2008: in press.

MATERIAL EXAMINED: MHNG INVE49716; Mediterranean, Spain, Mallorca, Cala Murada, depth 4m, 20 Aug. 1999; female and male colonies on roots and old leaves of *Posidonia oceanica*. – Italy, Calabria, Punta Palascia, depth 10-15m, 19 Aug. 2004, infertile colonies; private collection of D. De Vito. – Italy, Calabria, Punta Palascia, depth 10-15m, 8 Nov. 2006, infertile colonies; private collection of D. De Vito. – Italy, Calabria, Punta Facì, depth 5-10 m, 14 Dec. 2004, female and male colonies; private collection of D. De Vito.

DIAGNOSIS: Colonies branched, gastrodermis with numerous zooxanthellae, complementary nematocysts large microbasic euryteles, male blastostyle normal hydranth, female gonophores on hydranth with shortened tentacles.

DESCRIPTION: Colonies erect, branched, mostly monosiphonic, sometimes stem base moderately polysiphonic (2-4 tubes), perisarc smooth, occasional annulated stretches especially near origin of branches. Gastrodermis of coenosarc and hydranths contains zooxanthellae (Fig. 17), density variable, some hydranths may have only few zooxanthellae. Hydranths with one whorl of 25-30 tentacles, scattered large euryteles on hydranth body. Epidermis of hydranths often, but not always, with spumous inclusion bodies (Fig. 18D), especially between tentacle bases.

Male blastostyles develop as normal hydranths, not reduced when mature, with up to 10 sporosacs per hydranth, sporosacs two-chambered, with scattered euryteles, without terminal nematocyst button.

Female sporosacs develop concomitantly with hydranth bearing them, the latter remains usually somewhat reduced, the size small and the tentacles short; spadix simple, with scattered large euryteles; fertilized eggs encapsulated and attached to perisarc of blastostyle pedicels. Nematocysts: small and large microbasic euryteles. Colour: gastrodermis brownish due to zooxanthellae.

DIMENSIONS: Colonies up to 4 cm high; hydranths 0.5-0.75 mm high and 0.35 mm wide; pedicel diameters 0.1-0.16 mm. Small microbasic euryteles (7-8.5)x(3-3.5) μ m, r=2.1-2.8. Large microbasic euryteles (13-17)x(6-8.5), r= 1.9-2.6. Diameter of zooxanthellae 8.5-13 μ m.

BIOLOGY: Occurs in shallow waters from about 1 to 15 m.

DISTRIBUTION: Mediterranean, perhaps also southern Brittany (Castric *et al.*, 1987, as *Eudendrium hargitti*). Type locality: Mediterranean Sea, Morocco, Chafarinas Islands.

REMARKS: Except for the zooxanthellae, this species resembles closely – or is indistinguishable – from *Eudendrium ramosum*. Some colonies from Calabria even

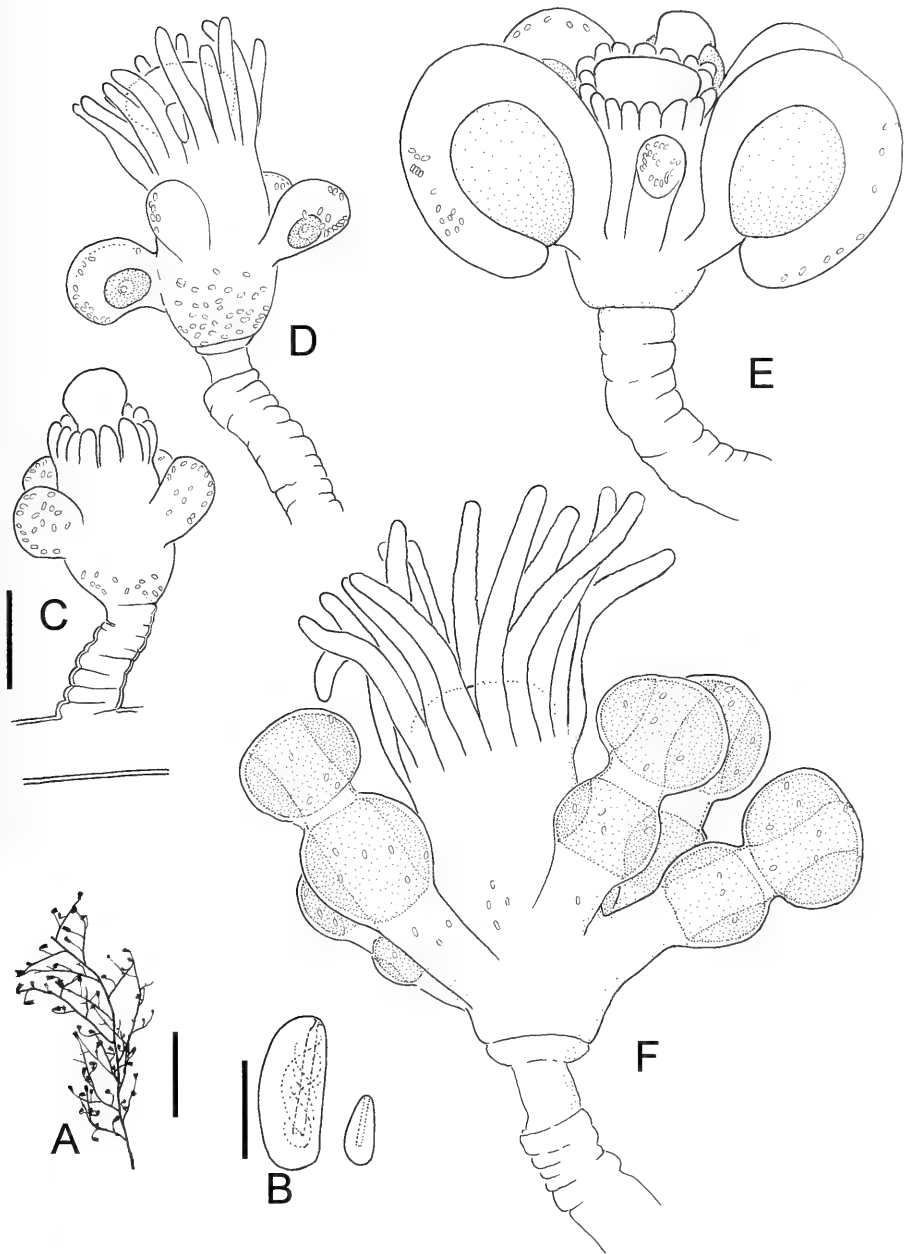


FIG. 16

Eudendrium moulouyensis Marques, Peña Cantero & Vervoort, 2000, after preserved material. (A) Colony silhouette, scale bar 1 cm. (B) Nematocysts: undischarged large and small micro-basic euryteles, scale bar 10 μ m. (C) Developing female blastostyle, scale bar 0.2 mm. (D) More advanced female blastostyle, same scale as C. (E) Mature female blastostyle, same scale as C. (F) Mature male gonozooid, same scale as C.



FIG. 17

Eudendrium moulouyensis Marques, Peña Cantero & Vervoort, 2000; hydranth with stained zooxanthellae (iodine reaction); scale bar 0.1 mm.

had a moderately polysiphonic stem base, thus reinforcing the similarity. The density of the zooxanthellae is variable, while some hydranths have only few, others of the same colony may have many. The density is also variable between colonies.

Several samples had conspicuous white inclusion bodies in the epidermis, especially between the tentacle bases. They are easily visible in living and preserved material as white spots. Under the microscope, these bodies look like spumous cells (Fig. 18D). The content does not react with iodine, thus it contains no starch, nor is it calcareous as it does not react with lactic acid. Not all colonies have them. Identical spumous bodies were also found in some *E. ramosum*. It is not clear what these inclusions are; perhaps they are parasitic protists.

Castric *et al.* (1987) depict a zooxanthellae containing *Eudendrium* they identified as *Eudendrium hargitti*. Although they give not enough details, the depicted microbasic eurytele matches *E. moulouyensis* rather than *Myrionema hargitti* (= *M. amboinense*) which has macrobasic euryteles. *Eudendrium moulouyensis* thus likely also occurs along the southern coasts of Brittany.



FIG. 18

Eudendrium moulouyensis Marques, Peña Cantero & Vervoort, 2000, microscopic preparations of preserved material from Otranto, scale bar 10 μm valid for all sections. (A-B) Undischarged large euryteles. (C) Small microbasic euryteles. (D) Undischarged large euryteles and a spumous inclusion body (centre).

Eudendrium* cf. *merulum Watson, 1985

Figs 19-20

Eudendrium merulum Watson, 1985: 200, figs 53-58. – Bavestrello & Piraino, 1991: 200, figs 2-4. – Marques *et al.*, 2000a: 100, figs 64-66. – Marques *et al.*, 2000b: 203. – Peña Cantero & García Carrascosa, 2002: 30, fig. 5a-b. – Bouillon *et al.*, 2004: 59, fig. 35A-G.

MATERIAL EXAMINED: MHNG INVE49879; Black Sea, Bulgaria, Varna, St. Constantine and Helena yacht port; 1 m; 17 Aug. 2003; female colonies. – MHNG INVE49880; Bulgaria, Varna, St. Constantine and Helena yacht port; 1 m; 14 July 2003; female and male colonies. –

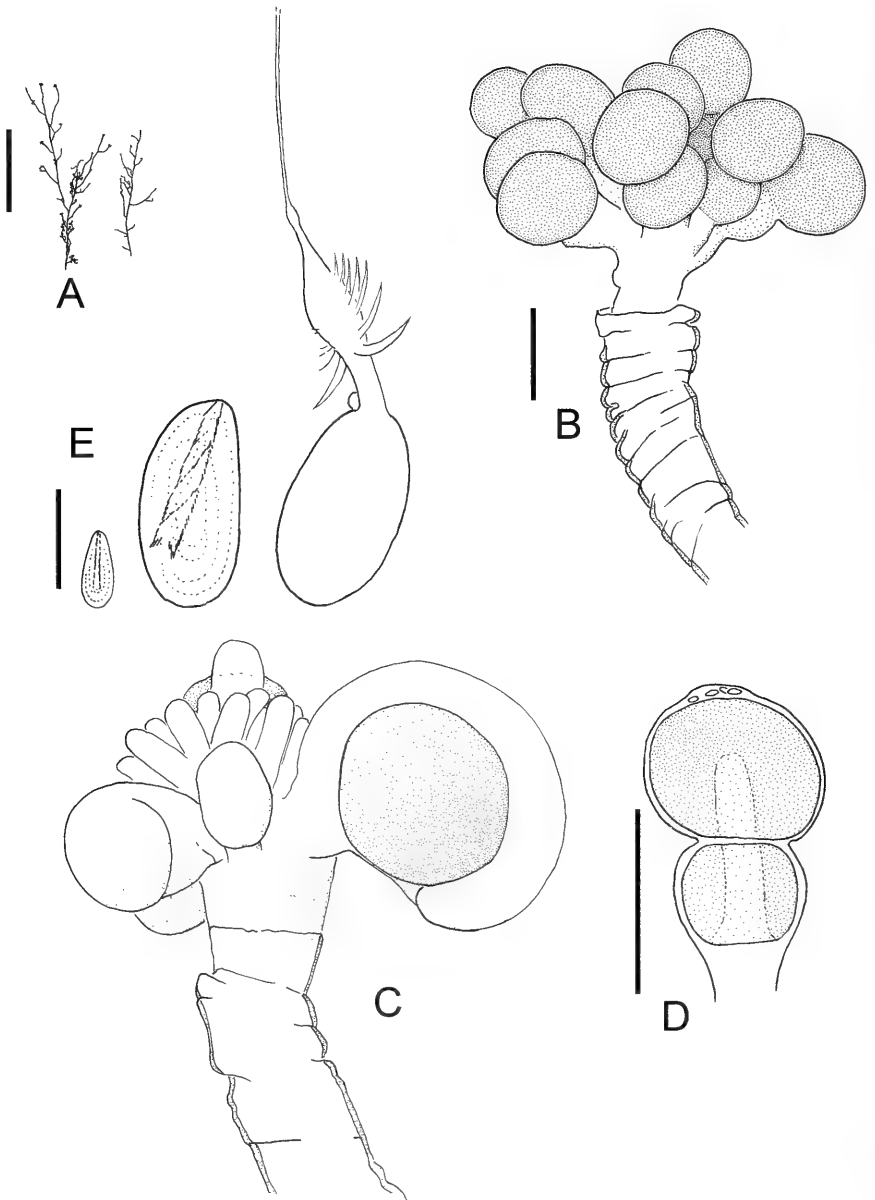


FIG. 19

Eudendrium cf. *merulum* Watson, 1985; A-C after preserved material from the Black Sea, D after Mediterranean material. (A) Colony silhouettes, scale bar 1 cm. (B) A small male blastostyle, note that they can be larger and comprise twice as many sporesacs; scale bar 0.2 mm. (C) Female blastostyle, some gonophores at early stages of development, short tentacles are present; same scale as B. (D) Male sporesac in semitransparent view, note terminal button with a few nematocysts; scale bar 0.1 mm, (E) Nematocysts: small microbasic euryteles, undischarged and discharged large microbasic eurytele, note the prominent spines; scale bar 10 μ m.

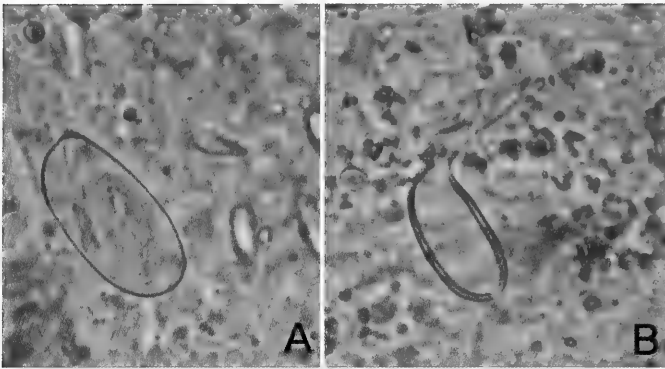


FIG. 20

Eudendrium cf. *merulum* Watson, 1985; complementary microbasic eurytele of colony from the English Channel. Length of undischarged capsule 21–23 μm , magnifications of A and B are not identical. (A) Undischarged capsule. (B) Same discharged.

MHNG INVE55454; Black Sea, Bulgaria, Varna, St. Constantine and Helena yacht port; 1 m; 30 July 2007; female and male colonies; 16S DNA sequence accession number of one male stem **AM991291**. – MHNG INVE55455; Bulgaria, Varna, St. Constantine and Helena yacht port; 1 m; 25 July 2007; female and male colonies; 16S DNA sequence of one male colony identical to **AM991291**. – Italy, Otranto, Punta Faci; 5–10 m; 25 July 2005; infertile; pers. collection D. De Vito. – Italy, Otranto, Punta Faci; 1–5 m; 23 July 2004; infertile; pers. collection D. De Vito. – English Channel, France, Normandy, Cotentin Peninsula, Agon; depth 0 m; 20 Aug. 2005; small infertile monosiphonic colonies on sponge; material not preserved, all used for nematocyst examination and DNA extraction; 16S DNA sequence accession number **AM991300**. – Atlantic, Spain, Cantabria, Noja, Playa de Ris, depth 0–2 m; 19 Jul. 2003; small stolonial colony on sponge, male blastostyles completely reduced, large (24 μm) supplementary microbasic euryteles with thick shaft; material not preserved, all used to make DNA, 16S DNA sequence identical to **AM991300**. – MHNG INVE27670, as *Eudendrium* cf. *merulum*; Canary Islands, Tenerife, Radazul, 20–30 m; 2 Oct. 1999; male and female colonies.

DIAGNOSIS: Colonies branched, monosiphonic, cnidome comprises large microbasic eurytele having a thick shaft and large spines; male blastostyle completely reduced, gonophores without terminal button; female blastostyles reduced hydranth with rudimentary tentacles and without hypostome.

DESCRIPTION: Colonies erect, branched, monosiphonic, arising from creeping stolons. Stems with up to 15 hydranths, rarely more; perisarc with smooth, corrugated, or annulated stretches. Hydranths as typical for genus, 16–24 tentacles; basal groove near proximal end, large nematocysts scattered on hydranth body, sometimes concentrated in indistinct band above basal groove.

Male blastostyles completely reduced, sporosacs as tuft at end of pedicels, 1–2 chambered, rarely a third smaller proximal chamber present, connection between chambers thick, without distinct neck, terminal nematocyst button with some large euryteles can be present in mature sporosacs.

Female blastostyle small, reduced hydranth without hypostome, with few tentacle rudiments, about 4–6 sporosacs per blastostyle; sporosacs with simple, curved spadix. Fertilized eggs encapsulated in thin perisarc membrane and attached to blastostyle pedicels.

Nematocysts: small microbasic euryteles occurring predominantly on tentacles; large microbasic euryteles, shaft of undischarged capsule spanning 3/5 of capsule and rather thick, discharged shaft also thick and with strong swelling, with numerous and strong barbs, thread relatively thick and also barbed.

Colours (Bavestrello & Piraino, 1991); hydranths are whitish.

DIMENSIONS: Stems usually up to 2 cm, diameter of hydranth pedicels 0.18-0.2 mm, hydranths 0.45-0.6 mm from groove to mouth, stem diameter at base 0.15 mm. Small microbasic euryteles $(6-8) \times (2.5-4) \mu\text{m}$, $r = 2-2.8$; large microbasic euryteles $(18-26) \times (9-13.5) \mu\text{m}$, $r = 1.8-2.4$ (nematocyst measured in preserved material).

BIOLOGY: Occurs in depths of 1-15 m. In the Mediterranean and Black Sea it grows on rocks, barnacles and other solid substrata, gonophores were observed from January to August. The Atlantic colonies grew on sponges and other substrates.

DISTRIBUTION: Australia (Watson, 1985); Yemen (Marques *et al.*, 2000a); western and eastern Mediterranean (Bavestrello & Piraino, 1991; Marques *et al.*, 2000b; Peña Cantero & García Carrascosa, 2002); Black Sea (new record); Canary islands, Gulf of Biscaya and English Channel (new records, but see below). Type locality: Bass Strait, Victoria, Australia.

REMARKS: *Eudendrium merulum* as conceived by Marques *et al.* (2000b) and also the present paper resembles *E. ramosum*, but has completely or strongly reduced blastostyles. The shaft of the large microbasic euryteles of *E. merulum* also differs in being much thicker and in having large spines (comp. Figs 13 and 19E). Marques *et al.* (2000b) state that the male sporosacs have a narrow connection between the successive chambers. This was not found in the material examined in this study.

Some available 16S sequence data (publication in preparation, see also Fig. 2) indicate that the Atlantic, Mediterranean, and Black Sea populations here attributed to *E. merulum* belong to at least three unrelated lineages, likely representing three different biological species. As it is likely that they are also distinct from the Australian *E. merulum*, the species as currently perceived is certainly a species complex and it was here therefore listed as *Eudendrium* cf. *merulum* only.

Eudendrium merulum was originally described based on material from southern Australia, where it is a rather rare species (J. Watson, pers. com.). Bavestrello & Piraino (1991) then found several Mediterranean colonies that matched the diagnosis of *E. merulum*. Later also Marques *et al.* (2000b) described additional Mediterranean material. The referral to the European material to the Australian *E. merulum* is somewhat arbitrary, it could as well have been attributed to *E. kirkpatricki* Watson, 1985. This is especially true for the material seen in this study which had female blastostyles with some tentacle rudiments. In the previously described specimens, the female blastostyles were completely atrophied. However, the presence of rudimentary tentacles on the blastostyles is often only transitory and their presence/absence falls within the intraspecific variation observed in other species. Other observed slight differences to the description of Watson (1985) and Bavestrello & Piraino (1991) concern the male gonophore: they have 1-2 chambers instead of 2-3, lack the thin neck between them, and have an occasional terminal button with some euryteles. All these small differences are thought to be insignificant, or in current taxonomic practice they are considered at

least insufficient to separate different species. The material from the Canaries was particularly difficult to evaluate and differed from the other samples, but without showing acceptable diagnostic traits that would have allowed diagnosing it as a distinct species. The colonies were much larger (10 cm, mostly monosiphonic, shape resembling *E. ramosum*), the stem diameter was much thicker than in the other *E. merulum* (0.34 mm), the hydranths were larger (0.7 mm), the spadix longer with a tendency to form a spiral, and the large euryteles were larger (25-30 μm long) and they were concentrated in an indistinct band near the basal groove. The colonies appeared thus intermediate between *E. ramosum* and *E. arbuscula*.

Eudendrium merulum is part of the *E. ramosum* group, which comprises several *Eudendrium* species with a large complimentary eurytele and which are often not reliably identifiable (see also Marques, 1995). It is unlikely that detailed morphological analyses of allopatric populations can provide us with reliable species diagnoses. Useful diagnostic features might become more evident only after a DNA analysis will have provided us with a robust phylogenetic tree of the species.

***Eudendrium annulatum* Norman, 1864**

Figs 21-24

Eudendrium annulatum Norman, 1864: 83, pl. 9 figs 1-2. – Hincks, 1868: 83, pl. 15 fig. 1. – Allman, 1872: 339. – Bétencourt, 1899: 4, pl. 1 figs. 1-4. – Bonnevie, 1898a: 482, pl. 26 figs 31-33. – Broch, 1910: 201. – Broch, 1916: 62, fig. T. – Fraser, 1944: 62, pl. 7 fig. 33. – Christiansen, 1972: 289.

in part *Eudendrium annulatum*. – Jäderholm 1909: 51, pl. 4, figs 3-4. – Naumov, 1969: 265, fig. 134.

not *Eudendrium annulatum*. – Leloup, 1940: 5, 29. – Yamada, 1954: 2, text-fig. 1.

not *Eudendrium annulatum*. – Schuchert 2001: 26, fig. 15A-C. [= *E. vaginatum* Allman, 1863]

Eudendrium cf. *arbuscula*. – Schuchert, 2001: 33, fig. 21. [not *Eudendrium arbuscula* Wright, 1859]

TYPE MATERIAL EXAMINED: BMNH 1898.5.7.40; syntypes of *Eudendrium annulatum* Norman, 1864; Shetland Isles, Burrafirch Caves, "Burness Hall"; coll. 1863; 2 infertile colonies, one colony likely depicted in Norman (1864). – RMNH Coel28436, syntype (slide preparation); Great Britain, Shetland, Burrafirch Caves, "Burness Hall".

OTHER MATERIAL EXAMINED: BELUM Md363; Scotland, Outer Hebrides, Scarba, NE Rubh A Chuil; 56°11.96'N 05°41.30'W; 27 m; 12 July 1982; infertile. – BELUM Md628; Scotland, Outer Hebrides, St. Kilda, NE of Stac Lee; 57°52.01'N 08°30.45'W; 25 m; 9 July 1984; infertile. – BELUM Md421; Scotland, Outer Hebrides, Scarba, Bealach a Choin Glais (Grey Dogs Race); 56°12.50'N 05°41.70'W; 17 July 1982; infertile. – BELUM Md108, as *E. ramosum*; Northern Ireland, Donegal, south side of Rathlin O'Birne; 54°22.38'N 05°33.15'W; 30m; 21 Nov. 1976; fertile females and males. – BELUM Md109; Northern Ireland, Donegal, Torneady Point; 55°01.51'N 08°32.43'W; 36 m; 8 April 1978; infertile. – BELUM Md629; Northern Ireland, Antrim, Rathlin Island, NE of Farganlack Point; 55°18.74'N 06°15.06'W; 24m; 7 July 1984; infertile. – BELUM Md630; Northern Ireland, Antrim, Maidens, W Side of The Bushes; 54°55.38'N 05°43.84'W; 25m; 25 July 1983; infertile.

DIAGNOSIS: Large polysiphonic colonies, stems with bark-like covering, hydranths large (>0.4 mm diameter), usually with basal ring of large microbasic euryteles, blastostyles aggregated on upper side of branches, their pedicels relatively short, gonophores with distal nematocyst buttons.

DESCRIPTION: Colonies large, stiff, rather stout and coarse, stems and branches polysiphonic, typically with rather elongate stem or primary branches provided with shorter side-branches resembling somewhat a bottle-brush (Fig. 21A). Stem and

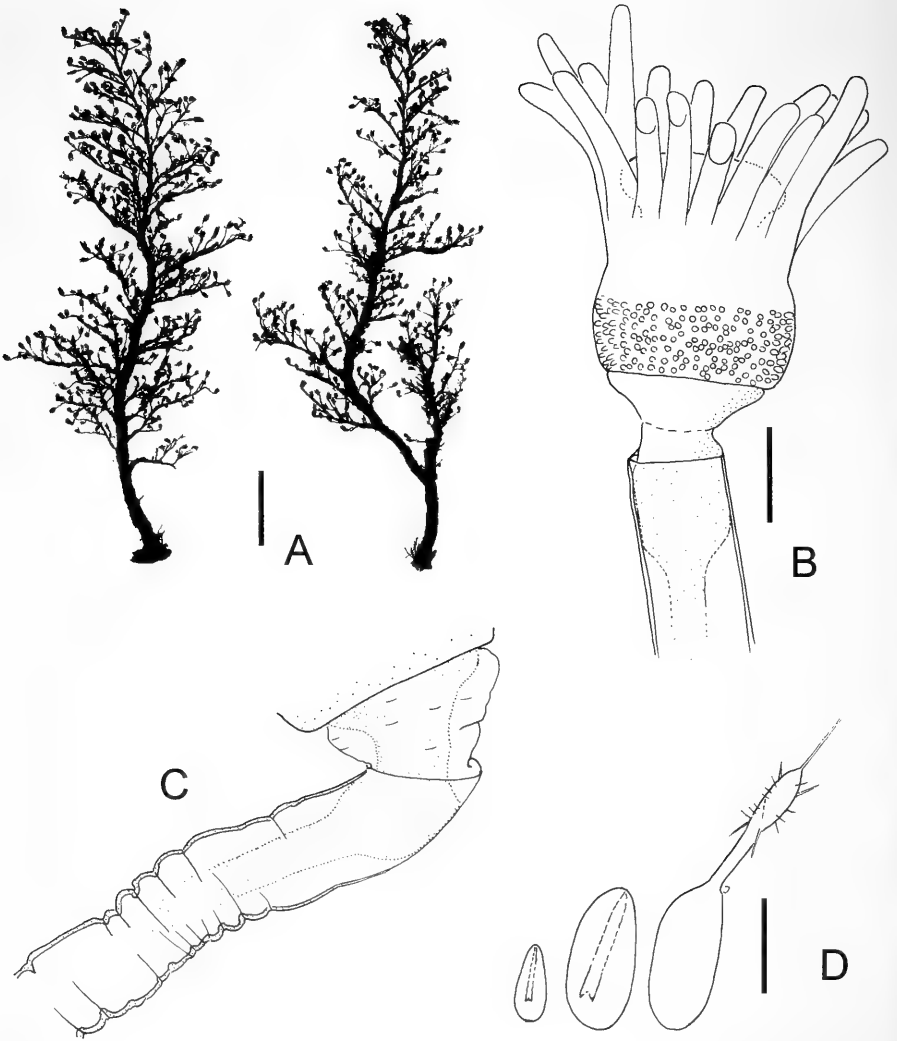


FIG. 21

Eudendrium annulatum, after preserved material from Northern Ireland. (A) Colony silhouettes showing typical colony form, scale bar 1 cm. (B) Typical hydranth, note broad band of nematocysts on body, no perisarc collar present, scale bar 0.2 mm. (C) Terminal branchlet and hydranth base with short, filmy perisarc collar, same scale as B. (D) Nematocysts: small microbasic euryteles, large microbasic eurytele, large eurytele discharged.

thicker branches often covered by a smooth layer of coalesced stolonial tubes forming a dense-meshed, bark-like covering (Fig. 23). Perisarc of branches brown, thick, with smooth stretches and some annulated or corrugated stretches. Hydranths large, 16-22 tentacles, on body a broad band densely beset with large euryteles, these may be missing or inconspicuous in some colonies; basal groove marked, near base of body, filmy perisarc originating in basal groove sometimes loose and forming a short perisarc

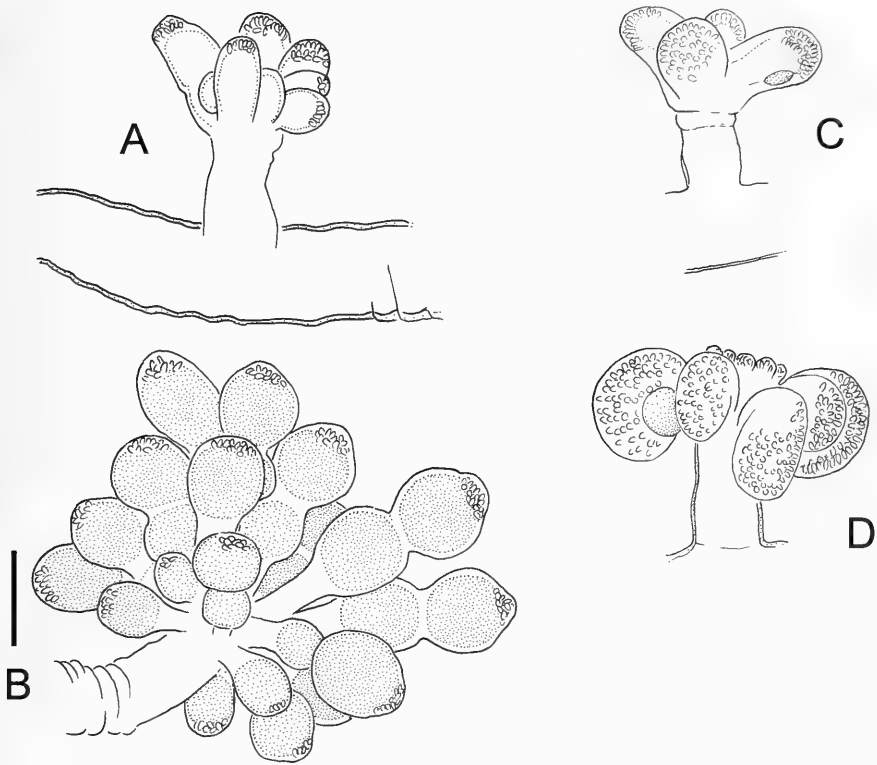


FIG. 22

Eudendrium annulatum, after preserved material from Northern Ireland. (A) Developing male blastostyle, note presence of large euryteles at the tips of the developing gonophores, same scale as B. (B) Mature male blastostyle, scale bar 0.2 mm. (C) Developing female blastostyle, in the gonophore at right an immature egg is visible, same scale as B. (D) Slightly more advanced female blastostyle than shown in C, the spadices with euryteles curve over immature eggs, some tentacle rudiments with large euryteles are visible at the top, same scale as B.

collar (Fig. 21C). Colonies dioecious, blastostyles on short pedicels, often in dense aggregates on upper side of distal, monosiphonic hydrocladia (Fig. 24).

Male gonophores are formed in tufts at the end of short branchlets (Fig. 22A), hydranths absent at all stages of development, distal ends of sporosacs with numerous large eurytele capsules, mature gonophores 1-2 chambered, when two-chambered both chambers equivalent, terminal nematocyst button nearly always present (Fig. 22B).

Female gonophores develop like male ones at end of branchlets, eggs present at early stage, curved spadix beset with euryteles, during later development some transient, very short tentacle rudiments may form (Fig. 22C-D) that are later lost.

Nematocysts: small microbasic euryteles in tentacles; larger microbasic eurytele, relatively rounded capsule, shaft in intact capsule ca. $\frac{3}{4}$ of capsule length, discharged slightly longer than capsule, directed obliquely, distinctly swollen and with coarse spines, unambiguously identifiable as eurytele. Colours: perisarc brownish, hydranths white.



FIG. 23

Eudendrium annulatum, type colony, bark-like overgrowth on stem.

DIMENSIONS: Colony height 4-10 cm. Hydranth diameter below tentacles 0.35-0.57 mm, height from basal groove to mouth 0.5-0.6 mm. Diameter of hydranth pedicels 0.18-0.24 mm. Small eurytele (8-9.5) \times (3.5-4.5) μ m, $r= 2-2.7$. Large eurytele (15-17) \times (6.5-7.5) μ m, $r= 2.1-2.5$.

BIOLOGY: Insufficient data on fertility periods are available, perhaps fertile during autumn and winter (comp. examined material; Bétencourt, 1899).

DISTRIBUTION: North Atlantic, boreal to Arctic regions (Norman, 1864; Levinsen, 1893; Bonnevie, 1898a; Broch, 1910, 1916; Fraser, 1944; Naumov, 1969; Christiansen, 1972). The southernmost trustworthy record is by Bétencourt (1899) for



FIG. 24

Eudendrium annulatum, preserved material from Northern Ireland showing male blastostyles in dense stands on upper side of hydrocladium.

the English Channel, although he had beached material only. There are also several unreliable records. Type locality: Shetland Isles, Burrafirth, Bunness Hall cave, depth 0.3 m below ELWS.

REMARKS: The epithet of *E. annulatum* is misleading. Neither the type material nor the other samples from Scotland and Ireland are extensively annulated. There are annulated stretches at the origin of branches and some hydranth pedicels are entirely annulated, but most of the perisarc is smooth. The suggestive name has occasionally led other authors to use it for species with a complete annulation like *E. ritchiei* (see e.g. Millard, 1975).

Eudendrium annulatum has been synonymized with *E. vaginatum* Allman, 1863 by Marques *et al.* (2000a), but this is incorrect (see discussion under *E. vaginatum*).

It has so far been ignored that *E. annulatum* has usually a belt of nematocysts on the hydranth body and that it has male gonophores with terminal nematocyst buttons (Figs 21B, 22A-B). It resembles thus closely *E. arbuscula* Wright, 1859 with which it also shares the same nematocysts and the characteristics of the blastostyles. However, both species appear to be distinct and their differences are given under *E. arbuscula* and in the key to the species. The belt of nematocysts can apparently be absent in some specimens. In the syntype material, only one colony of the two had such a belt.

The material from Spitsbergen identified by Leloup (1940) as *E. annulatum* was re-examined for this study (IRSNB IG12981). It is a small *Eudendrium*, originally growing on *Halecium muricatum*, and it does unlikely belong to *E. annulatum*. The state of the material does not allow a reliable identification, but it resembles *E. capillare*.

Eudendrium arbuscula Wright, 1859

Figs 25-27

not *Tubularia arbuscula* D'Orbigny, 1846.

Eudendrium arbuscula Wright, 1859: 113, pl. 9 figs 5-6.

Eudendrium arbusculum. – Hincks, 1868: 84, pl. 14 fig. 1. – Calder, 1972: 225, pl. 2 fig. 5.

Eudendrium arbuscula. – Allman, 1872: 336. – Bonnevie, 1899: 50. – Broch, 1928: 113. – Weill, 1934a: 77, fig 70a-b. – Weill, 1934b: 386, fig. 236. – Castric & Michel, 1982: 82, fig. – Marques & Vervoort, 1999: 16. – Marques *et al.*, 2000b: 81, figs 11-15. – ICZN, 2000: 180-181. – Faasse & Vervoort, 2005: 61, fig. 4, photos 4, 7, 8.

Eudendrium rigidum Allman, 1876: 253, pl. 9 figs 3-4. – Kramp 1926: 242, synonym.

Eudendrium wrightii Hartlaub, 1905: 547, new name.

? *Eudendrium caricum* Jäderholm, 1908: 5, pl. 1 fig. 4, pl. 2 fig. 1. – Calder, 1972: 225, synonym.

Eudendrium wrighti. – Broch, 1916: 60, map. T.

not *Eudendrium arbusculum*. – Hamond, 1957: 300, figs. 7, 8.

not *Eudendrium arbuscula*. – Marinopoulos, 1992: 58, fig. 1.8.

not *Eudendrium cf. arbuscula*. – Schuchert, 2001: 33, fig. 21. [= *E. annulatum*]

TYPE MATERIAL EXAMINED: ZMUC; syntype material of *Eudendrium rigidum* Allman, 1876; Denmark, Middelfart Sund; infertile; leg. Lütken, compare Kramp (1926: 242). – BMNH 1912.12.21.98; ?syntype of *Eudendrium rigidum* Allman, 1876; Denmark; infertile.

OTHER MATERIAL EXAMINED: ZMUC, as *Eudendrium wrighti*; Denmark, off Treindelens Lightship; 27 Jul. 1904; infertile. – ZMUC, as *Eudendrium wrighti*; Denmark, Little Belt; depth 16-20m; 26 March 1915; infertile. – BELUM Md424; 55° 13.51'N 06° 38.97'W; Northern Ireland, Antrim, NW of Little Skerry Potrush; depth 36m; 03 Aug. 1982; infertile. – BELUM Md492; 54°23.39'N 05°34.64'W; Northern Ireland, Down, Strangford Lough, Ballyhenry Island; depth 25m; 30 June 1982; infertile. – BELUM Md624; 54°41.66'N 05°47.15'W; Northern Ireland, Antrim, Belfast Lough, SE of Carrickfergus; depth 7.5m; 15 May 1984; infertile. – BELUM Md627; 55°08.82'N 07°04.95'W; Northern Ireland, Londonderry, Lough Foyle, East Channel; depth 7.5m; 22 June 1983; infertile. – BELUM Md626; 51°30.04'N 09°17.70'W; Ireland, Cork, Lough Hyne, E Whirlpool Cliff; 31 Aug. 1974; infertile. – BELUM Md625; 51°26.90'N 09°49.45'W; Ireland, Cork, SW of Mizen Head; 16 July 1983; infertile. – BELUM

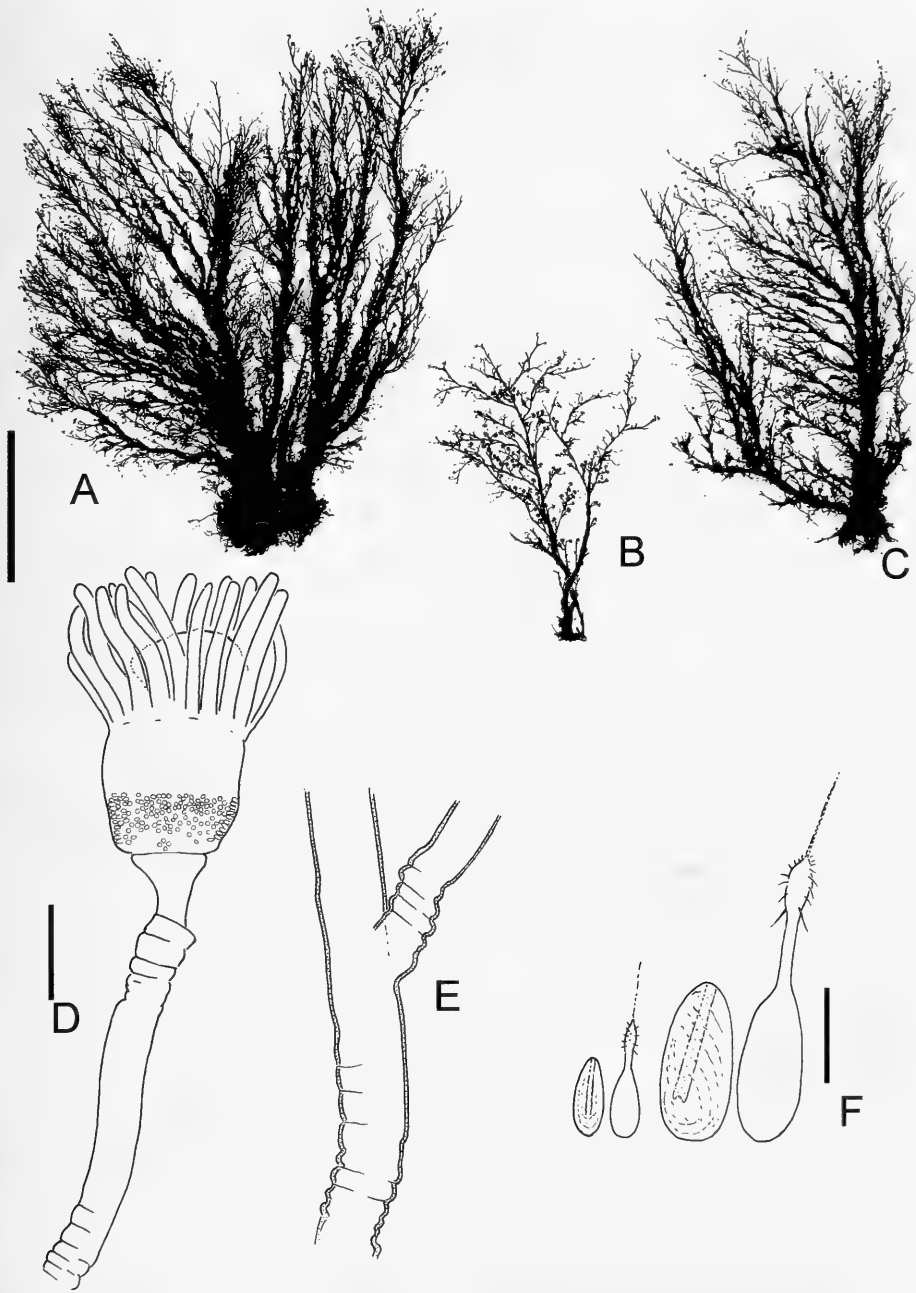


FIG. 25

Eudendrium arbuscula Wright, 1859, after preserved material from Northern Ireland. (A-C) Colony silhouettes, scale bar 2 cm. (D) Hydranth with nematocyst belt, scale bar 0.2 mm. (E) Perisarc of branch, same scale as B. (F) Nematocysts: undischarged and discharged small and large euryteles, scale bar 10 μ m.

Md535; 57°57.79'N 05°31.30'W; Scotland, Outer Hebrides, Summer Isles, W Priest Island; 7 Sept. 1981; fertile male. – RMNH-Coel 30986; The Netherlands, Zeeland, Goesse Sars; 15 Nov. 2003; female colonies. – RMNH-Coel 30985; The Netherlands, Zeeland, Zeelandbrug-Noord; 9 Oct. 2004; male colonies. – RMNH-Coel 30983; The Netherlands, Zeeland, Zeelandbrug-Noord; 8 Oct. 1998; male colonies. – RMNH-Coel 30992; The Netherlands, Zeeland, Zeelandbrug-Noord; 9 Oct. 2004; female colonies.

DIAGNOSIS: Colonies polysiphonic, much branched, up to 6 cm, stems without bark-like covering, hydranths small (<0.3 mm diameter), with basal belt of microbasic euryteles, blastostyles dispersed, without hydranths, gonophores with distal nematocyst buttons.

DESCRIPTION: Colonies bushy, irregular, much branched, usually with numerous terminal branches and rather dense, either with a rather short basal trunk or no clear trunk but several main branches issuing from hydrorhiza, polysiphonic, thinning out to monosiphonic terminal branches, in polysiphonic parts tubes usually rather loosely and irregularly aggregated and not neatly parallel; perisarc with smooth, corrugated and annulated stretches, never annulated throughout. Stem not covered by bark-like covering of coalesced stolonial tubes.

Hydranths relatively small, 16-25 tentacles, on body a broad, dense belt of large euryteles, basal groove faint, near base of body (Fig. 25D). Colonies dioecious, blastostyles dispersed over colony.

Male gonophores develop in tufts at the end of branchlets (Fig. 26A), hydranths absent at all stages of development, distal end of sporosacs with numerous large euryteles, mature gonophores one-chambered, sometimes a second proximal swelling, rarely a second chamber, terminal nematocyst button nearly always present.

Female gonophores develop at the end of branchlets (Fig. 26B), concomitantly with gonophores a small hydranth develops, it has only a small body, short tentacles stumps, and no hypostome; at later stages it may be reduced entirely; curved spadix with nematocyst buttons containing large euryteles; after fertilization spadix reduced, embryos encased in thin membrane and several ones attached along pedicels of former blastostyles.

Nematocysts: small microbasic euryteles in tentacles; large microbasic euryteles, shaft in intact capsule ca. $\frac{3}{4}$ of capsule length, discharged slightly longer than capsule, directed upwards, distinctly swollen and with coarse spines, unambiguously identifiable as eurytele.

Colours: perisarc light brownish, hydranths white or rose-orange.

DIMENSIONS: Colonies 2-6 cm. Hydranth diameter below tentacles 0.17-0.3 mm; height from basal groove to mouth 0.28-0.5 mm; hydranth pedicel diameter 0.10-0.12 mm. Small euryteles (7-8.5)x(2.5-3.5) μm , $r = 2.3-2.5$. Large euryteles (14-17)x(6-7.5) μm $r = 2.1-2.7$.

BIOLOGY: Occurs in rather shallow depths down to about 40 metres. Faasse & Vervoort (2005) found fertile colonies only during wintertime.

DISTRIBUTION: From Brittany to Norway, also North Sea (Jäderholm, 1909; Broch, 1916; Kramp, 1942; Rees & Rowe, 1969; Christiansen, 1972; Castric *et al.*, 1987; Marques *et al.*, 2000a; Faasse & Vervoort, 2005); more frequent along the

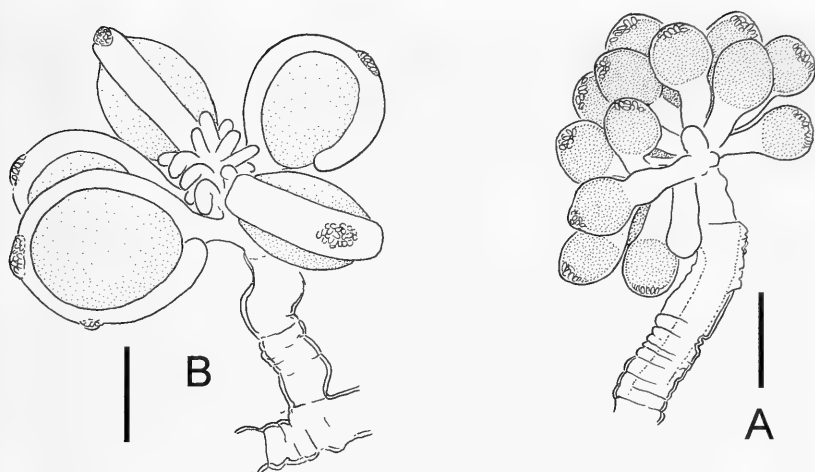


FIG. 26

Eudendrium arbuscula Wright, 1859, blastostyles after preserved material from Holland, scale bars 0.2 mm. (A) Male sporosacs, note terminal button with nematocysts. (B) Female sporosacs

Danish and Irish coast; perhaps also Portugal (Da Cunha, 1944) and NW Atlantic (Calder, 1972). Due to the unclear synonymy the distribution pattern is not well known. The Mediterranean records (e. g. Marinopoulos, 1992) are likely misidentifications. Type locality: Queensferry (close to Edinburgh), Firth of Forth, Scotland.

REMARKS: Because *Tubularia arbuscula* D'Orbigny, 1846, an indeterminate species, is perhaps referable to the genus *Eudendrium*, Hartlaub (1905) proposed the new name *Eudendrium wrightii* for *E. arbuscula* Wright, 1859. Following the proposal of Marques & Vervoort (1999), the International Commission of Zoological Nomenclature (2000) decided that the name *Eudendrium arbuscula* Wright, 1859 (Cnidaria, Hydrozoa) is to be conserved and placed it on the list of the official names. The spelling of the specific epithet is *arbuscula* as it is a noun in apposition (Marques & Vervoort, 1999).

Unfortunately, no type material of *Eudendrium arbuscula* could be located, it must be considered as lost. *Eudendrium arbuscula* Wright, 1859 was initially characterized (Wright, 1859b) by the broad band of nematocysts on the hydranth body and the terminal nematocyst button of male sporosacs. Wright's description does not permit to distinguish it with absolute certainty from *E. annulatum* as conceived here. However, as Wright describes the branches as very slender and depicts male sporosacs with one chamber, it can be excluded with reasonable probability that his material belonged to *E. annulatum* Norman, 1864. The present scope of *Eudendrium arbuscula* is thus almost certainly correct.

Eudendrium arbuscula nonetheless resembles *E. annulatum*, notably they share the same nematocysts, the polysiphonic colonies, the belt of euryteles on the hydranth, the terminal nematocyst buttons of the gonophores, and the type of blastostyles. They differ in characters that are usually regarded as taxonomically quite unreliable and both could arguably be regarded as only two different forms of the same species.

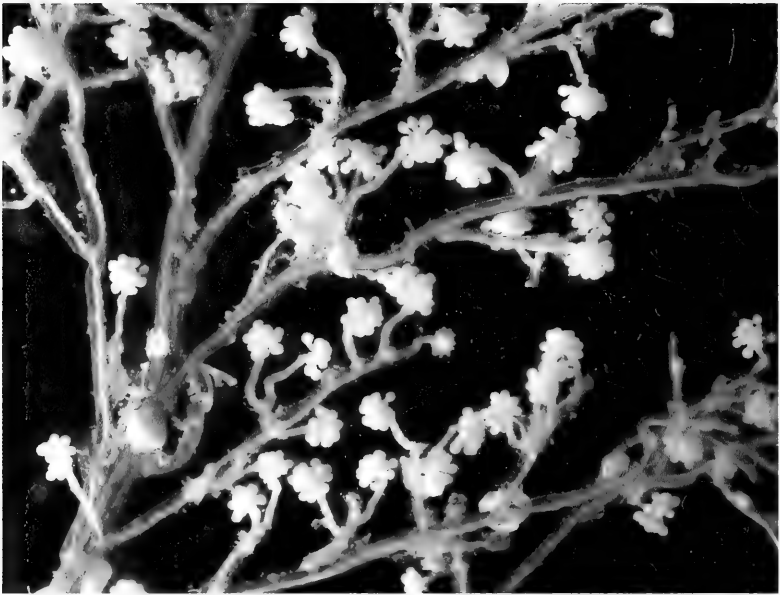


FIG. 27

Eudendrium arbuscula Wright, 1859, male blastostyles in preserved material from Northern Ireland.

However, material of both species from the same region (Northern Ireland) was strikingly distinct when compared side by side. The colony forms differ (comp. Fig. 21A and 25A), *Eudendrium annulatum* forms more open, coarse, and rather stiff colonies. The main branches are often covered by a bark-like overgrowth, which is diagnostic for *E. annulatum* when present. The hydranths of *E. annulatum* are distinctly larger, the diameters are nearly twice as large as those of *E. arbuscula*. Another difference is the distribution of the blastostyles, which occur in dense stands on the upper side of distal branches in *E. annulatum*, while they are not so regularly grouped in *E. arbuscula* (based on rather few observations, difference may be due to limited number of observations). The pedicels of the blastostyles of *E. annulatum* are relatively short.

Eudendrium rigidum Allman, 1876, based on infertile material from Denmark, was synonymized with *E. arbuscula* by Kramp (1926). The type material of *E. rigidum* was also examined for this study and the results confirmed Kramp's findings.

The Greenlandic material identified by Schuchert (2001) as *Eudendrium* cf. *arbuscula* had stems with a bark-like covering, which is found only in *E. annulatum* and *E. vaginatum*. Colony size and form matched *E. annulatum* and the material is therefore here re-assigned to the latter species.

Calder (1972) proposed that also *Eudendrium caricum* Jäderholm, 1908 could be a synonym of *E. arbuscula*. Due to the similarity of *E. annulatum*, the type material of *Eudendrium caricum* should be re-examined to prove this possibility.

Hamond's (1957) material identified as *E. arbuscula* unlikely belongs to this species. The colonies were rather small and both female and male gonophores

developed on normal hydranths and not reduced blastostyles. Hamond's material most probably belongs to an unnamed species. It could not be named here as Hamond's description is not complete enough and no material could be located. Note that also the fertility period given by Hamond (summer) does not agree with the observations of Faasse & Vervoort (2005) made for *E. arbuscula* of the neighbouring Dutch coast.

***Eudendrium calceolatum* Motz-Kossowska, 1905** Fig. 28

Eudendrium calceolatum Motz-Kossowska, 1905: 59, fig. 2. – Picard, 1955: 182. – Marinopoulos, 1992: 58, figs 1.7, 2.1. – Marques *et al.*, 2000b: 203.

DIAGNOSIS: Springly branched colonies, hydranth with belt of large nematocysts, some capsules also dispersed. Gonophores on normal hydranth, male one two-chambered, female ones with spadix that has a distal triangular swelling (axe-like shape). Complementary capsules are large microbasic euryteles (Marinopoulos, 1992), (20-30) × (8-13) μm, on hypostome, body, and hydrocaulus; shaft in undischarged capsule thick, with two swellings, spanning 2/3 of capsule.

DESCRIPTION: See Motz-Kossowska (1905).

DISTRIBUTION: Endemic to the Mediterranean, recorded from Banyuls (Motz-Kossowska, 1905), Algeria (Picard, 1955), and Marseille (Marinopoulos, 1992). Type locality: Banyuls-sur-Mer, close to marine laboratory, on *Cystoseira* algae of rocky littoral.

REMARKS: This is an insufficiently known species and Marques *et al.* (2000b) considered it dubious. Marinopoulos (1992; via pers. com. by J. Picard) mentions that is now very rare, although it was once common in the vicinity of Marseille. The species is characterized by the axe-shaped spadix of the female gonophore.

***Eudendrium capillaroides* new spec.** Figs 29-30

? *Eudendrium teissieri*. – Fey, 1970: 392. [nomen nudum]

? *Eudendrium tessieri*. – Castric *et al.*, 1987: 97, fig. [note variant spelling]

TYPE MATERIAL: Syntype colonies MHNG INVE36293; Atlantic Ocean, France, Brittany, Bay of Morlaix, more than 20m depth, 13 Sept. 2004, female colonies on ascidians (including also *Styela clava*), accession number of partial 16S gene sequence **AM991306**.

OTHER MATERIAL: France, Camaret near Brest, depth 20-30m, 18 Sept. 2006, infertile colony on *Nemertesia antennina*, not preserved, used to make DNA, 16S sequence identical to AM991306.

DIAGNOSIS: Colonies small, monosiphonic, female gonophores borne on incompletely developed hydranths, these later reduced entirely or nearly so, spadix simple; males unknown; cnidome comprises two euryteles of slightly different size (length ratio 1.3).

DESCRIPTION: Colonies small, monosiphonic, sparsely and irregularly branched, up to 10 hydranths per stem. Perisarc smooth with occasional short annulated or irregularly corrugated stretches, usually at origin of branches and hydranth pedicels. Hydranths with up to 25 tentacles, hypostome relatively large, tentacular nematocyst confined to proximal 2/3 of tentacles, arranged in regular rings, nematocyst oblique to tentacle axis giving it thus a spiny appearance. Perisarc groove on hydranth body well marked, relatively distal (basal third of body, Fig. 29B).

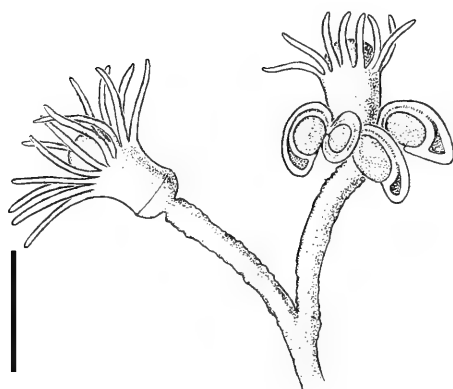


FIG. 28

Eudendrium calceolatum Motz-Kossowska, 1905, infertile and fertile hydranth, note particular shape of spadices, scale bar 0.5 mm, modified from Motz-Kossowska (1905).

Female gonophores (up to 6) formed on blastostyles that concomitantly develop about 12-18 tentacles of reduced size, tentacles later atrophied, no hypostome formed, spadix simple, long and thin (Fig. 29D). In older stages tentacles strongly atrophied or lost, spadices shed and the embryos in their transparent capsules attached irregularly along the pedicel of the former blastostyle (Fig. 29E-F).

Male gonophores not known.

Nematocysts: microbasic euryteles of two different size classes (Fig. 30), size ratio of length of larger and smaller eurytele 1.3, ratio of width of larger and smaller eurytele 1.4, larger capsule thus somewhat thicker. Smaller capsule abundant on tentacles, also on hydranth body and coenosarc. Larger capsules (complementary nematocysts) scattered in a band above the perisarc groove and also in coenosarc of stem and pedicels.

DIMENSIONS: Stems 5-12 mm high; hydranth height about 0.3-0.4 mm, width 0.2-0.35 mm; hydranth pedicels diameter 0.12 mm, stem diameter at base 0.12-0.13 mm; encapsulated eggs about 0.2 mm. Nematocyst dimensions in preserved material see table 1.

TABLE 1. *Eudendrium capillaroides* new. spec., dimensions in [μ m] and proportions of nematocysts, values from two preserved colonies

	length of tentacular capsules	width of tentacular capsules	length of larger capsules	width of larger capsules
mean	6.5	2.7	8.5	3.9
s. error of men	0.30	0.34	0.27	0.18
range	6-7.5	2.5-3.5	7-9	3.5-4.5
number of values	25	25	24	24
ratio length/width	2.4		2.2	

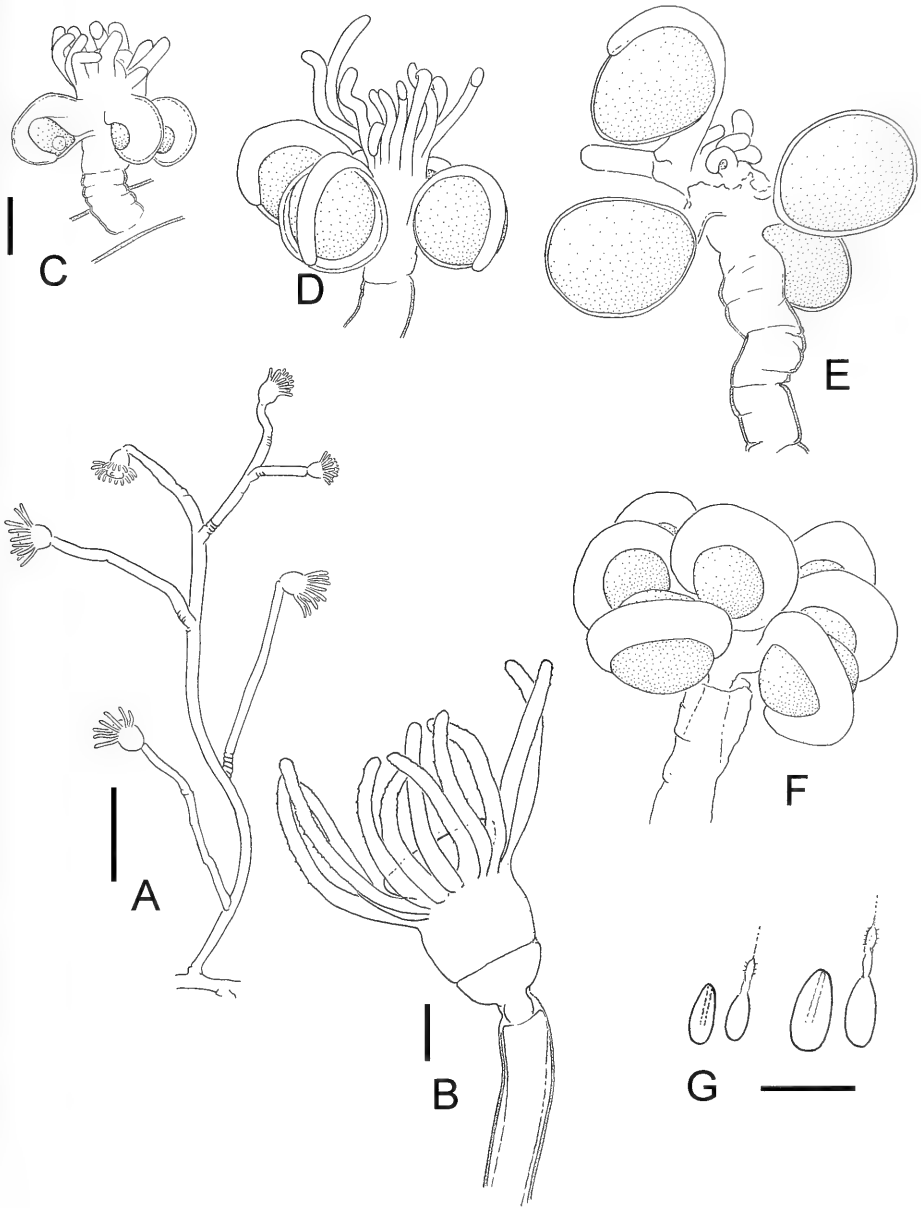


FIG. 29

Eudendrium capillaroides new spec., after preserved type material. (A) One stem of colony, scale bar 1 mm. (B) Hydranth, scale bar 0.1 mm. (C) Early developmental stage of female blastostyle, scale bar 0.1 mm. (D-F) Later stages of female blastostyle, note atrophy of hydranth and tentacles, same scale as C. (G) Cnidome: two microbasic euryteles of different size classes, pairs of intact and discharged capsules, scale bar 10 μ m,

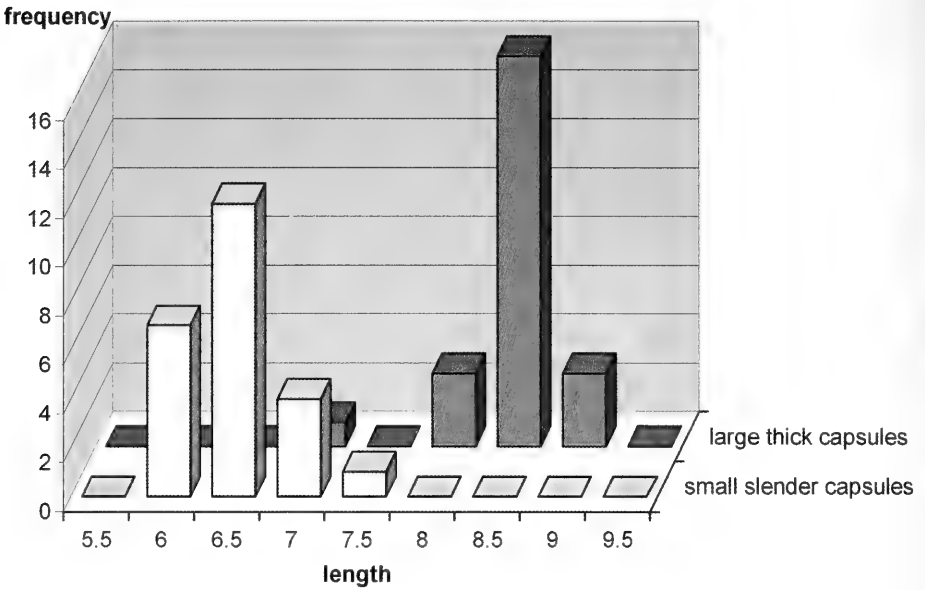


FIG. 30

Eudendrium capillaroides new spec., frequency distribution of the lengths of the two nematocyst capsules, length in μm .

BIOLOGY: Occurs in depths of 20-30 m.

DISTRIBUTION: Brittany. Type locality: France, English Channel, Bay of Morlaix, about 20 m depth.

ETYMOLOGY: The specific epithet refers to the similarity to *E. capillare*, a species with which it was initially confused.

REMARKS: This species resembles very closely *E. capillare*, the only difference being their cnidomes. The cnidome of *E. capillaroides* comprises heteronemes of two slightly different size classes, the ratio of their lengths being 1.3. The larger capsule is somewhat thicker, the width ratio of the two types being 1.4. Although the dimensions intergrade somewhat (table 1, Fig. 30), it is rather easy to see in a microscopic squash preparation that there are actually two different populations of capsules. The cnidome makes it immediately distinguishable from the otherwise similar *E. merulum* which has much larger complimentary euryteles (see key to species). 16S sequence data confirmed that *E. capillare*, *E. capillaroides*, and the European *E. merulum* are clearly distinct lineages (Fig. 2). A species with a similar cnidome is *E. maorianus* Schuchert, 1996 from New Zealand, whose morphology, except for the bifid spadix, is almost identical. Also *E. maorianus* has two types of euryteles that differ only minimally, the ratio being also about 1.3. Interestingly, its 16S sequence is also rather similar to *E. capillaroides* (Fig. 2).

It is likely that *E. capillaroides* corresponds to the invalid nominal species *Eudendrium teissieri*. Fey (1970), in a study dealing with the hydroids of the Glenan Islands in southern Brittany, listed also *Eudendrium* sp. 3, with a remark that this species would be described as *E. teissieri* by Cabioch in a forthcoming publication. However, this apparently never happened and the name *Eudendrium teissieri* is not valid (ICZN art. 13.1). It was not possible to locate any original material. Castric & Michel (1982) and Castric *et al.* (1987) later included the name in a key to a faunistic guide under the name *Eudendrium tessieri* [note different spelling], solely providing a sketch of the hydranth and the complementary nematocysts. Also this publication cannot be seen as a valid introduction of the name. There is no accompanying text, but the sketch indicates that the complementary nematocysts are relatively small and concentrated in a band on the hydranth body.

***Eudendrium vaginatum* Allman, 1863**

Figs 31-32

Eudendrium vaginatum Allman, 1863: 10. – Allman, 1872: 339, pl. 14 figs 7-8. – Jäderholm, 1909: 53, pl. 3 figs 10-11. – Nutting, 1901: 167, pl. 15 figs. 3-6. – Fraser, 1944: 76, pl. 13 fig. 52.

not *Eudendrium vaginatum*. – Bonnevie, 1898a: 484, pl. 26 figs 24-26. – Weill, 1934a: 77, text-fig. 70a-b. – Weill, 1934b: 389, text-fig. 239.

? *Eudendrium vaginatum*– Berrill, 1952: 22, figs 7-8.

Eudendrium annulatum. – Levinsen, 1893: 154. – Schuchert, 2001: 26, fig. 15A-C. [not *Eudendrium annulatum* Norman, 1864]

in part *Eudendrium vaginatum*. – Marques *et al.* 2000a: 107, fig. 85. [others = *E. annulatum*]

MATERIAL EXAMINED: BMNH 1912.12.21.99; Scotland, Shetland Islands, Balta Sound; depth 90m, non-type specimen; coll. A. M. Norman (material of Norman, 1869), all soft tissues gone, colony typical. – ZSM 20040386, as *Eudendrium insigne*; Norway, Bergen; no collection date; infertile colonies on laminarian algae, with numerous well preserved hydranths, undischarged larger microbasic euryteles with shaft coiled near origin. – RMNH Coel28403; as *Eudendrium insigne*; Norway, Bergen; slide made of ZSM 20040386. – RMNH Coel28437; 65.42°N 52.93°W; Greenland, Sukkertoppen; slide preparation; female, but tissues damaged, depicted in Marques *et al.* 2000a, has large microbasic euryteles, undischarged shaft curved near origin. – IRSNB IG11365; Canada, Newfoundland, Trinity Bay, whaling station; material mentioned of Leloup (1939b); well preserved male colony, has typical large eurytele with coiled shaft. – Norway, Korsfjord, Great Skorpa Island; depth 80-160m; triangular dredge; 16 June 2006; on rock; infertile, material not preserved. – Icelandic Museum of natural History, sample BIOICE2000; 65.354°N 13.794°W; Iceland; 26m; 18 July 1987; infertile; figure published in Schuchert (2001) as *E. annulatum*; re-examined material & changed id. 4 Apr. 2007.

DIAGNOSIS: Branched colonies, mostly polysiphonic when mature, straggling growth, perisarc often dark-brown, rigid, sharply and regularly annulated throughout, with bark (stolonial overgrowth of stem), irregular, convoluted; perisarc originates in groove in upper half of hydranth body and not at base, in preserved material giving impression of pseudohydrotheca; complementary capsule a microbasic eurytele with one small coil in undischarged capsule, discharged shaft longer than capsule.

DESCRIPTION: Colonies much branched, shrubby, straggling in appearance, rather stiff and bristly, stem thick, monosiphonic or more usually polysiphonic, branches mostly monosiphonic and short, branching irregular, branches often curved and of uneven length. Hydrorhiza creeping stolons, anastomosed to tight-meshed net on even surfaces, smooth perisarc. Tubes of stem and branches comparatively thick,

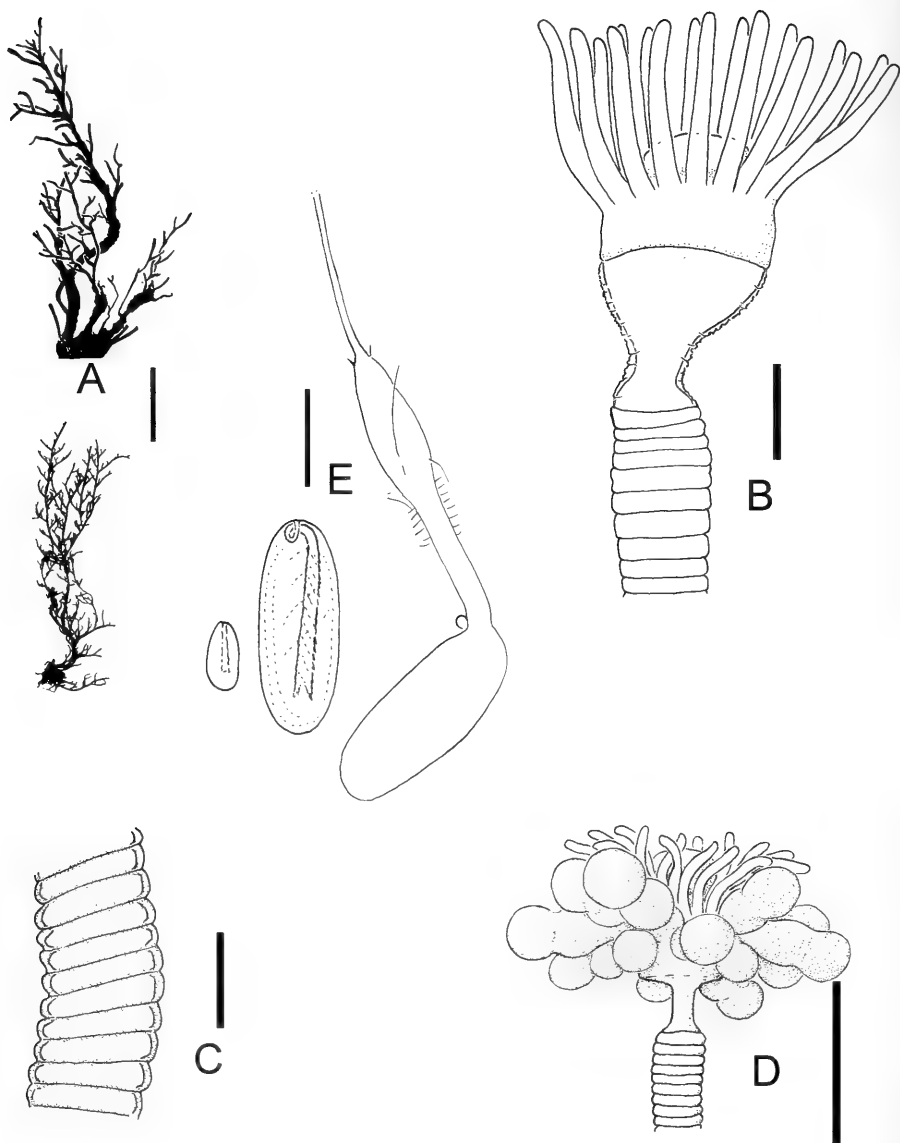


FIG. 31

Eudendrium vaginatum, all except of E after preserved material, D redrawn from Jäderholm (1909). (A) Colony silhouettes, top colony from Iceland, below one from the Shetland Islands, scale bar 5 mm. (B) Hydranth with the characteristic pseudohydrotheca, scale bar 0.2 mm. (C) Part of branch showing the annulation of the perisarc that is present throughout the colony, scale bar 0.2 mm. (D) Young male gonozooid, in more advanced stages the hydranth is reduced variably, scale bar 0.5 mm. (E) Nematocysts: small undischarged microbasic eurytele, large undischarged and discharged microbasic euryteles; scale bar 10 μ m.

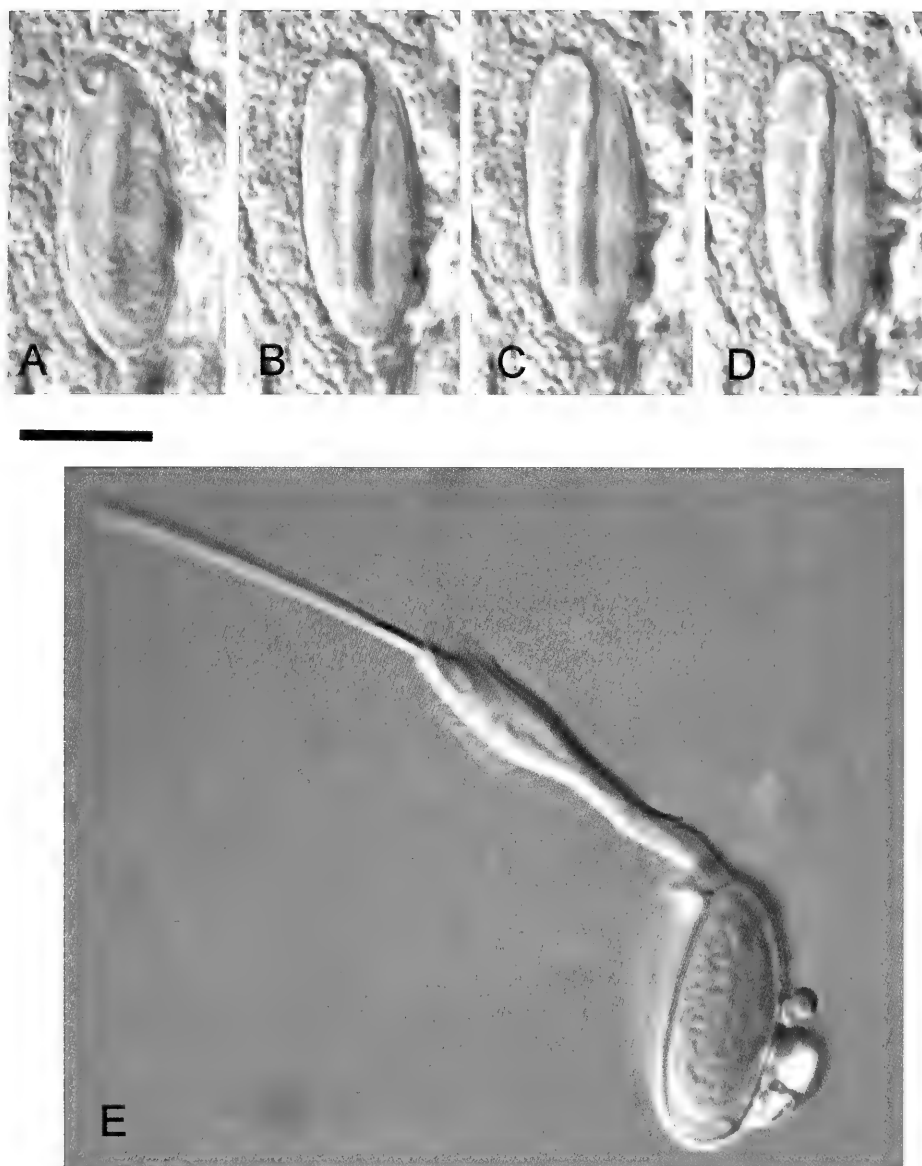


FIG. 32

Eudendrium vaginatum Allman, 1863, native capsules from Norwegian material, scale bar 10 μm . (A-D) Undischarged capsule, the four sections depict the same capsule, but in different focusing planes, note the small coil of the shaft near its origin. (E) Discharged capsule, note the length of shaft which surpasses the capsule length.

annulated throughout, annulation distinct and very regular (Fig. 31C). Base of colony often overgrown by smooth, contorted, stolon-like tubules forming a bark-like covering.

Hydranths with 18-20 tentacles, perisarc originates as thin film in well defined groove in upper half of fully grown hydranth body, perisarc thus forming a characteristic closely adhering cup-like pseudohydrotheca (or loose and collar-like in preserved material that has undergone some tissue shrinking).

Gonophores on normal or somewhat atrophied hydranths. Male gonophores initially on normal hydranths, in more advanced stages reduced (hypostome disappears, tentacles shorten, body gets smaller), gonophores two chambered, more than 10 per hydranth. Female gonophores with unbranched spadix on normal polyps or polyps with shortened tentacles, hypostome present (at least in younger stages), six or more gonophores per hydranth.

Colours: perisarc light to dark brown, sometimes almost black; soft tissues characteristically red.

Nematocysts: small tentacular microbasic euryteles and large microbasic euryteles, in dense ring on hydranth body primarily along groove and on hypostome, shaft in undischarged capsule thick, forming a small, complete coil near junction to capsule wall (Figs 31E, 32A-D), coil diameter about 1/10 of capsule length; discharged shaft distinctly longer than capsule ($s > 1.5$, Fig. 32E), thick, distal half much swollen, barbed even along narrow part, tread thick.

DIMENSIONS: Colonies up to about 3 cm high. Hydranth height from base to mouth about 0.5 mm. Hydranth pedicel diameters 0.2-0.4 mm. Annulation of perisarc 50-70 μm high. Small microbasic euryteles (7-8) \times (3-4), $r = 2-2.8$; large microbasic eurytele (20-23) \times (9-9.5) μm , $r = 2.2-2.6$.

BIOLOGY: Depth range 0-180 m, known substrates are rock and laminarians.

DISTRIBUTION: An Arctic to northern boreal species, with reliable records from the Shetland Islands (Allman, 1864; this study), Norway (this study), Jan Mayen (Jäderholm, 1909), Iceland (Schuchert, 2001 as *E. annulatum*; this study), Western Greenland (this study), Newfoundland (Leloup, 1939; this study). Pacific records (e. g. Nutting, 1901; Stechow, 1913; Fraser, 1937) need confirmation by examining their nematocysts. Type locality: Shetland Isles, in rockpools at ELS level and below.

REMARKS: *Eudendrium vaginatum* Allman, 1863 is a characteristic species that can also be identified in the absence of gonophores. The hydranth produces the perisarc from a circular groove located in the upper half of the hydranth body, this in contrast to most other *Eudendrium* species where it is located in the basal region. The newly formed filmy perisarc thus adheres to the lower part of the hydranth like a pseudohydrotheca (easier to observe in preserved material that has undergone some tissue shrinking). Further characteristic traits of the species are the completely and regularly annulated perisarc, the dark-brown colour of the perisarc, and the red colour of the living tissues. Although the high position of the groove is very typical for this species, the location could be variable to some degree, but in the examined hydranths (>30), the vast majority had the groove in the upper half of the hydranth.

Although the type material could not be examined – it could not be found in the museums of London, Edinburgh nor Dublin – the characteristics listed above allow to identify the samples listed above quite unambiguously as belonging to Allman's *Eudendrium vaginatum*. Several of these samples permitted the examination of the

nematocysts. Besides the normal tentacular microbasic euryteles, there is also a large microbasic eurytele with a relatively long and thick shaft. The discharged shaft is distinctly longer than the capsule, but the ratio is smaller than 2.5, which qualifies it as a microbasic eurytele. In the undischarged capsule, the shaft forms a characteristic tiny coil near the junction with the capsule wall (Figs 31E, 32). This type of capsule is rather uncommon, but another *Eudendrium* in the NE Atlantic has a similar, but distinguishable capsule (see *Eudendrium unispirum*; coil in capsule ca. 1/3 of capsule length).

With these results at hand, it is thus evident that *E. vaginatum* Allman, 1863 and *E. annulatum* Norman, 1864 are distinct species. Both species have occasionally been synonymized (e. g. Marques *et al.*, 2000a). When Normann (1864) described *E. annulatum*, he stated: "the tubes [hydranth pedicels] are not expanded at their extremities to receive the polypites, as is the case in some allied species". This remark certainly concerns *E. vaginatum*, which at the time of Norman's writing (December 1863) had already been published (January issue of the same journal). This is also reflected in his Latin diagnosis: "... *polypis calices non expansos obsidentibus*,..." Thus Norman likely wanted to keep his species distinct from Allman's one. Although I found some *Eudendrium annulatum* hydranths with a filmy perisarc collar (Fig. 21C), these were rare and rather small, unlike in typical *E. vaginatum* where they extend up to the middle of the body of fully grown hydranths (Fig. 31B). The perisarc of *Eudendrium annulatum*, despite its name, is not annulated throughout. Both *E. annulatum* and *E. vaginatum* form a bark-like covering of the stem base. In the former species (Fig. 23) it is rather regular and sheet-like, while in the latter it is more irregular and convoluted. Moreover, Norman has also found *Eudendrium vaginatum* at Shetland and he kept it distinct from his *E. annulatum* (see Norman, 1869). Norman's specimen (BMNH 1912.12.21.99) was re-examined for this study and it is evidently *E. vaginatum* (the nematocysts could not be examined, though).

Although Jäderholm's (1909) material could not be re-examined, his figures of the hydranth and the perisarc leave no doubt that his identification as *E. vaginatum* must be correct.

The material from Iceland described in Schuchert (2001) as *E. annulatum* was re-examined for this study. It is clearly referable to *E. vaginatum* and not *E. annulatum*.

Nutting (1901) attributed some samples from Alaska to *Eudendrium vaginatum*. Although his material was also completely annulated and possessed pseudohydrothecae, I think it could belong to a separate species as the female gonophores were borne on reduced hydranths. An examination of the nematocysts is necessary to establish the identity of the Alaskan population.

A number of other authors thought to have found *Eudendrium vaginatum*. However, as it has been confounded regularly with *E. annulatum* or *E. insigne*, most records are likely incorrect.

Eudendrium unispirum new spec.

Fig. 33

TYPE MATERIAL: Syntypes, BMNH 1948.9.8.82; several stems of one colony, originally identified as *Eudendrium album*; England, Plymouth; collected 1898 by E. T. Browne; growing on *Tubularia indivisa*; male colony.

OTHER MATERIAL: BELUM Md621; Northern Ireland, Down, Strangford Lough, W of Colin Rock, 54°25.54' N 005°36.33' W, depth 24m, 7 June 1989; infertile colony. – BELUM Md622; Northern Ireland, Down, Strangford Lough, SE of Abbey Rock, 54°25.51' N 05°35.12' W, 15m depth, 1 June 1983; infertile colony on stem of *T. indivisa*. – Spitzbergen, Svalbard, Hornsund, 2 small infertile colonies, coll. 12. July 2000 and 18 July 2006, depth about 16m, in private collection of Marta Ronowicz.

DIAGNOSIS: Small branched monosiphonic colonies, complementary nematocysts microbasic eurytele with shaft 2-2.4 times as long as capsule, in intact capsule coiled 1-1.5 times, coil large ($> 1/3$ capsule length). Male sporosacs on intact hydranths.

DESCRIPTION: Colonies delicate, bushy, monosiphonic, larger colonies much branched with up to 40 hydranths per colony, branching irregular, branches long. Perisarc mostly smooth, some annulation present, annulation usually present at origin of new branches and hydranth pedicels. Hydranths typical for genus but relatively small, 20-30 tentacles (mostly 24), on body a few scattered large nematocysts, more in circle around mouth, perisarc groove near base of body, usually difficult to see. Developing hydranth buds with layer of contiguous large euryteles.

Male sporosacs develop on intact hydranths, 2-4 per hydranth, 1-2 chambered, younger ones with distal tubercle with large nematocysts. Females unknown.

Nematocysts: small (tentacular) microbasic euryteles, shaft in intact capsule thick; large microbasic euryteles, discharged shaft 2-2.4 times as long as capsule, with spines along whole length but getting shorter towards capsule, in intact capsule shaft coiled with one to 1.5 turns, usually in upper half of capsule, size and form of coil somewhat variable from capsule to capsule but size $> 1/3$ capsule length, coiled part of shaft thin.

DIMENSIONS: Colonies from a few mm to 20 mm high. Hydranth diameter 0.1-0.18 mm, height from base to mouth 0.25-0.35 mm, hydranth pedicel diameter 0.06-0.10 mm, diameter of stem near base 0.13-0.17 mm. Nematocysts (from 4 preserved colonies): small microbasic eurytele (tentacular) $(6.5-7.5) \times (2.5-3.5) \mu\text{m}$; large eurytele $(19-22) \times (8-9.5) \mu\text{m}$.

ETYMOLOGY: The specific epithet is derived from the Latin words *uni* (single) and *spirum* (coil), an allusion to the conspicuous, single coil of the shaft in the complementary eurytele capsule.

BIOLOGY: The known depth range is 15-24 m. Two colonies were found growing on stems of *Tubularia indivisa*.

DISTRIBUTION: Plymouth (U. K.), Northern Ireland, Spitzbergen. Type locality: Plymouth, on stems of *Tubularia indivisa*.

REMARKS: This species resembles closely *E. album*. In fact, except for the complementary capsules, both species are identical. The undischarged complementary capsules of *E. unispirum* present a shaft that has only 1-1.5 coils, this in contrast to *E. album* which has four or five coils (Figs 6 and 33C). Also the lengths of the discharged shafts are significantly different. In *E. unispirum* the ratio of shaft/capsule length ($=$) is 2-2.4, in *E. album* it is larger than 5. As these characters shows rather little variation in *E. album*, the capsule of *E. unispirum* is quite reliably distinguishable. Applying

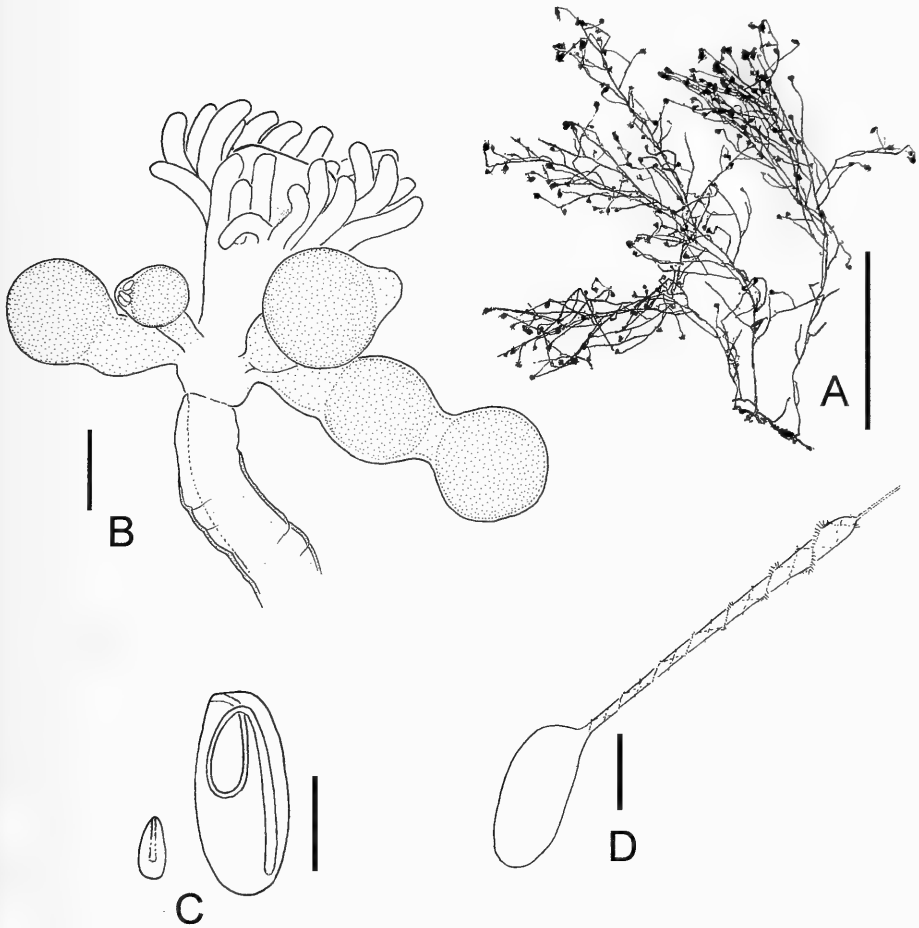


FIG. 33

Eudendrium unispirum new spec., after preserved material, A and D from Northern Ireland, B-C type material (A) Colony silhouette, scale bar 1 cm. (B) Hydranth with male sporosacs, scale bar 0.1 mm. (C) Undischarged nematocysts: small and large microbasic eurytele, scale bar 10 μ m. (D) Schema of discharged large microbasic eurytele, scale bar 10 μ m.

currently used diagnoses (e. g. Bouillon *et al.*, 2006), the shaft/capsule length ratio of <2.5 qualifies the complimentary capsules of *E. unispirum* as microbasic, while the one of *E. album* is macrobasic. A similar eurytele with one coil in the undischarged capsule is found in *E. vaginatum* (Fig. 32). However here the coil is very small and the species is otherwise rather easily separable from *E. unispirum* (see key on page 684).

Colonies of *Eudendrium unispirum* and *E. album* were found to occur sympatrically (Plymouth and Strangford Lough), which can be regarded as another argument for them being distinct species.

No female sporosacs could be found, but as the male sporosacs develop on normal hydranths, the same can also be expected for the female ones.

***Eudendrium capillare* Alder, 1856**

Fig. 34

Eudendrium capillare Alder, 1856: 355, pl. 12 figs 9-12. – Allman, 1864: 362. – Hincks, 1868: 84, pl. 14 fig. 2. – Allman, 1872: 335, pl. 14 figs 1-3. – Weismann, 1883: 109, pls 1-2. – Jäderholm, 1909: 53, pl. 3 figs. 8-9. – Bedot, 1914: 79. – Vervoort, 1946: 154, fig. 62. – Naumov, 1969: 263, fig. 132. – Calder, 1972: 226, pl. 2 fig. 6. – Millard & Bouillon, 1974: 17, fig. 3E-H. – Millard, 1975: 82, fig. 27E-J. – Kubota, 1976: 235, figs 3.7-8. – Cornelius & Garfath, 1980: 278, type material. – Calder, 1988: 41, fig. 30-32, synonymy. – Hirohito, 1988: 77, figs 24g-h, 25. – Marinopoulos, 1992: 60, fig. 3.1. – Marques *et al.*, 2000a: 88, figs 28-34. – Marques *et al.*, 2000b: 201. – Schuchert, 2001: 27, fig. 16A-F. – Peña Cantero & García Carrascosa, 2002: 27, fig. 4a-b. – Puce *et al.*, 2005: 202, figs 1b & 2c.

Corymbogonium capillare. – Allman, 1861: 171.

? *Eudendrium humile* var. *corymbifera* Allman, 1863: 10.

Eudendrium tenellum Allman, 1877: 8, pl. 4 figs 3-4. – Kramp, 1914: 99. – Fraser, 1937: 43, pl. 8 fig. 3. – Yamada, 1954: 17, fig. 15. – Calder, 1972: 226, pl. 2 fig. 8. – Hirohito, 1988: 88, fig. 31d-h. – Schuchert, 2001: 33.

Eudendrium hyalinum Bonnevie, 1898b: 7. – Bonnevie, 1899: 50. – Naumov, 1969: 263, synonymy.

Eudendrium tenue A. Agassiz, 1865: 160, fig. 250. – Bedot, 1914: 79, synonymy.

Eudendrium parvum Warren, 1908: 272, fig. 1, pl. 45 figs 1-4. – Millard, 1975: 82, synonymy

? *Eudendrium capillare* var. *mediterranea* Neppi, 1917: 30, fig. 1, pl. 4 figs. 1, 1a.

Eudendrium sagaminum Yamada, 1954: 14, fig. 12. – Hirohito, 1988: 77, synonymy.

not *Eudendrium capillare*. – Kramp, 1932a: 18. – Kramp 1932b: 7. [= *E. album*]

? not *Eudendrium capillare*. – Ramil & Vervoort, 1992: 18, fig. 1b-c.

TYPE MATERIAL EXAMINED: Syntype material of *E. hyalinum*, Bergen Museum no. 13628; Skjærgården St. 5-6, and no 10854, Bergens Skj. St. 3, 4, 5; 30-35 m. Both colonies infertile, originating from the vicinity of Bergen.

OTHER MATERIAL EXAMINED: MHNG INVE29390 Atlantic, France, Brittany, near St. Pol de Léon, 6 June 2000; depth 20m; on *Ciona intestinalis*; female colony; no haplonemes found; 16S sequence, **AY787884**. – Mediterranean, France, Banyuls-sur-Mer, October 1991, female colony on *Phallusia mammilata*, not preserved. – MHNG INVE32951; Mediterranean, France, port of Banyuls-sur-Mer; 9 May 2002; haplonemes present; depth 1m; male; 16S sequence **AM991296**. – MHNG INVE34231; Italy, Naples, Nisida; 14 April 1911; depth 1m, female. – MHNG INVE34234; Italy, Naples, Santa Lucia; 14 April 1911; depth 1m; male. – MHNG INVE36196; Mediterranean, France, Bay of Marseille; 24 April 1970, depth 5m; male and female colonies. – ZSM, Stechow collection; England, Plymouth, female. – BELUM Md616; Scotland, Outer Hebrides, St. Kilda, Levenish; 57.792°N 08.509°W; depth 30m; 18.07.1982; males and females. – BELUM Md619; Northern Ireland, Strangford Lough Narrows, Cloghy Rocks; 54.355°N 05.546°W; 7.5 m; 04.08.1983; males. – BELUM Md620; Northern Ireland, Strangford Lough Narrows, Rue Point; 54.365°N 05.541°W; depth 6m; 11.08.1983; females. – MHNG INVE37298; Atlantic, France, Normandy, Herquemoulin, Treize Vents; 22 Aug 2005; 0m; male; haplonemes rare; 16S sequence **AM991295**. – MHNG INVE54569; England; Plymouth, Firestone Bay; depth 12-18 m; 19 June 2007; on sponge and *Tubularia*; fertile female colony; haplonemes present; 16S DNA sequence **AM991294**. – MHNG INVE54592; England; Plymouth; depth 25m; 26 June 2007; on *Tubularia indivisa*; fertile female colony; haplonemes present. – England; Plymouth, Mew Stone; depth 25m; 23 June 2007; infertile colony; haplonemes present; material not preserved. – MHNG INVE54602; Spain; Basque Country, Guipúzcoa, Fuenterrabía; 0m depth; 12 July 2007; floating docks of harbour; fertile female colony; haplonemes present; 16S DNA sequence identical to AM991294. – MHNG INVE54696; Northern Ireland; Strangford Loch; 26 July 2007; fertile male colony; haplonemes present; 16S DNA sequence identical to AM991294.

DIAGNOSIS: Small monosiphonic colonies, cnidome comprises small microbasal euryteles and facultatively isorhizas of about the same size, both not concentrated in basal ring. Male blastostyle without tentacles, females with or without short tentacles, later atrophied, spadix simple.

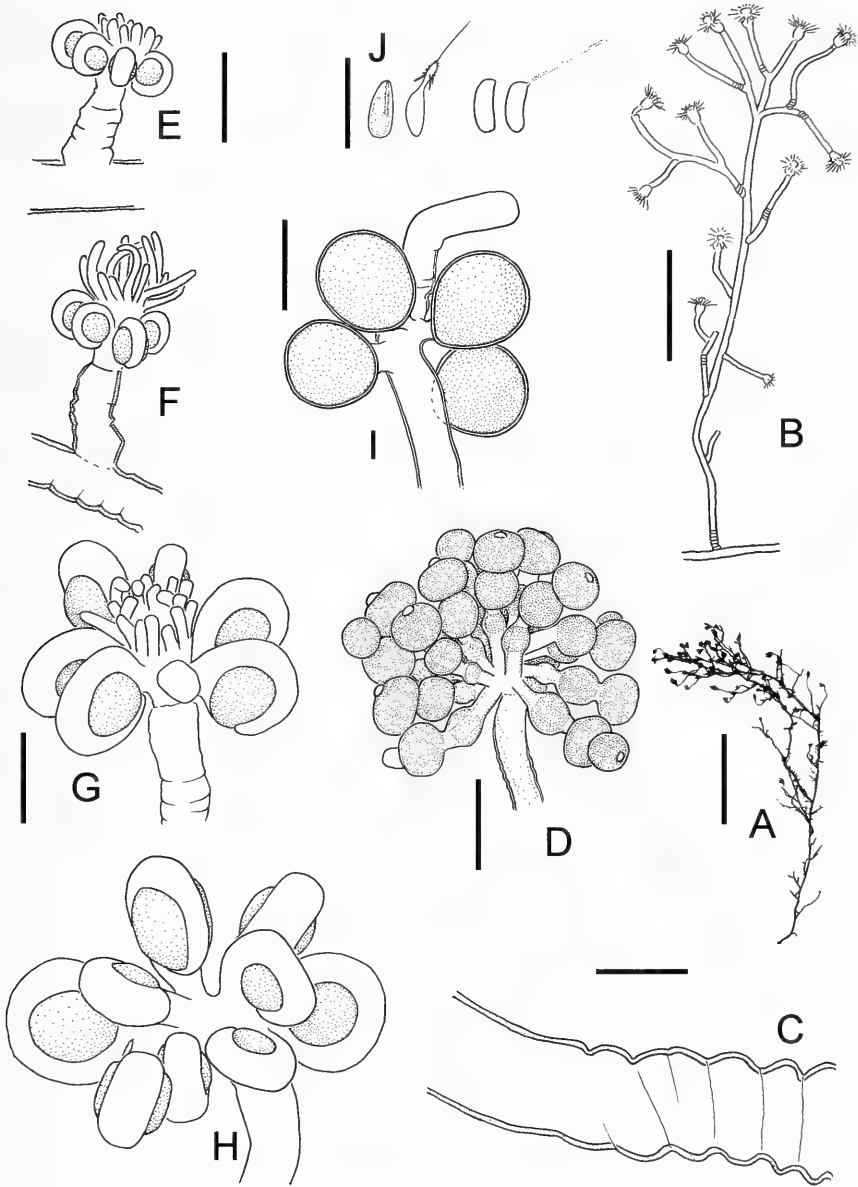


FIG. 34

Eudendrium capillare Alder, 1856; after preserved Mediterranean (B, D, H, I) and Atlantic (A, C, E-G, J) material. (A) Colony silhouette, scale bar 1 cm. (B) Single stem, scale bar 2 mm. (C) Higher magnification of branch with smooth and annulated perisarc, scale bar 0.1 mm. (D) Male blastostyle, scale bar 0.2 mm. (E-H) Sequence of development of female blastostyle, note the presence of short tentacles. In later stages (H) the blastostyle is completely reduced, scale bar 0.2 mm. (I) Encapsulated embryos attached to the former blastostyle pedicel, same scale as E. (J) Nematocysts: intact and discharged microbasic euryteles; intact and discharged haplonemes; scale bar 10 μm.

DESCRIPTION: Colonies small, delicate, monosiphonic, usually irregularly branched. Perisarc smooth with occasional short annulated or irregularly corrugated stretches, usually at origin of branches and hydranth pedicels. Hydranths with about 20 tentacles (15-24 range), hypostome relatively large, tentacular nematocyst confined to proximal $\frac{3}{4}$ of tentacles, arranged in regular rings, nematocyst oriented obliquely to tentacle axis, giving it thus a spiny appearance.

Male gonophores borne like tuft on blastostyles without tentacles at all stages, 12-15 gonophores and more per blastostyle, one- to three chambered, sometimes with terminal tubercle without nematocysts.

Female gonophores borne on hydranths with much shortened tentacles and body much reduced, hypostome absent; 5-12 eggs per blastostyle, with curved and unbranched spadix; in older stages tentacles completely atrophied. After fertilization the spadices are shed and the embryos in their transparent capsules attached irregularly along the pedicel of the former blastostyle.

Nematocysts: microbasic euryteles, one end tapering, not concentrated in a basal ring; isorhiza capsules with two blunt ends, same size as euryteles, numbers present rather variable, may be missing.

Colours: variable, either not much coloured, cream to light rose-orange, or red.

DIMENSIONS: Colony heights when mature 5 mm to 4 cm; hydranths 0.3-0.43 mm high (incl. hypostome), diameter of body 0.2-0.34 mm; stem diameter at base 0.12 mm; length of male gonophores 0.3-0.35 mm; embryos in capsules 0.2 mm. Microbasic euryteles (preserved material): Atlantic (3 colonies) (6-8)x(2.5-3) μm , $r=2.3-2.8$; Mediterranean (3 colonies) (5.5-9)x(2.5-4)mm, $r=2.4-2.9$. More measurements for other regions are given in Millard & Bouillon (1974), Millard (1975), Kubota (1976), Calder (1988), Marques *et al.* (2000b), and Peña Cantero & García Carrascosa (2002). All lie more or less within the limits given above. Haplonemes (preserved material): (5-6) x(2-2.5) μm .

OTHER DATA: Weismann (1883) described the oogenesis and the development of the female gonozooids. The oogonia become first visible in the gastrodermis of the coenosarc, although he could not localize their origin. The oogonia are present before the gonozooids develop. Fertilization takes place while the eggs were still clasped by the spadix. Later the spadix is shed and the embryos develop a chitinous envelope (similar to *E. racemosum*, see Fig. 9E). Neppi (1917) described the metamorphosis of the planula.

BIOLOGY: Occurs usually from zero to about 80 m depth, deeper records are known. Mature colonies have been observed May to September (NE Atlantic) or April to November (Mediterranean). The reproductive period is likely longer than indicated by these intervals. Grows on a variety of solid substrata and other animals and algae. Boero & Fresi (1986) found it regularly, sometimes abundantly, in a rocky zone of the Mediterranean. See also Boero (1981).

DISTRIBUTION: Reportedly nearly cosmopolitan, but only identifications using nematocyst information are reliable. Reliable records are from the northeastern Atlantic, Greenland, the Mediterranean, Bermudas, southern Africa, and Japan (Millard & Bouillon, 1974; Millard, 1975; Kubota, 1976; Calder, 1988; Schuchert,

2001). Along the European coasts certainly occurring from Norway to Gibraltar, including the North Sea but not the Baltic Sea (Jäderholm, 1909; Bouillon *et al.*, 1995; Peña Cantero & García Carrascosa, 2002; this study), also frequent in the Mediterranean (Marques *et al.*, 2000a, 2000b). Type locality: North Sea, Embleton Bay, Northumberland, Great Britain, on the hydroid *Nemertesia ramosa*.

REMARKS: Contrary to most other authors (Millard, 1975, South Africa; Watson, 1985, Australia; Calder, 1988, Bermuda; Marques *et al.*, 2000a Mediterranean), I occasionally found two types of nematocysts in this species. Besides the abundant, almond-shaped microbasic eurytele, there is a differently shaped haploneme (isorhiza, see Fig. 34J). It occurred in much lower and rather variable numbers. In some samples it was absent or very rare (Mediterranean), in others it was rare to quite frequent (NE Atlantic). Also Marinopoulos (1982) observed isorhizas in this species, although his schematic drawing (fig. 1.3) shows a different shape. The colonies which had them in higher numbers (Atlantic specimens) were indistinguishable from others in which these capsules were not noted. Because these capsules are usually much less frequent and have approximately the same size as the euryteles, they are very easily overlooked. Moreover, they discharge rarely in microscopic preparations. Preliminary 16S sequence data (Fig. 2) of colonies with haplonemes (see Material examined) and one colony in which it could not be found (MHNG INVE29390, AY787884) clustered all in one clade. I therefore assume that they all belong to one species and that *E. capillare* has variably also small haploneme capsules.

I have examined the type material of *E. hyalinum* Bonnevie, 1898b. The colonies are small, sparingly branched and infertile. I found only small capsules of one size class. *Eudendrium hyalinum* Bonnevie, 1898b is thus here regarded as a synonym of *E. capillare* as has been done before by Naumov (1969).

Allman (1877) described *E. tenellum* from infertile material without hydranths, he was even not sure whether it was a *Eudendrium*. This species – although it has been repeatedly identified by other authors – must certainly be considered unrecognizable. It was thought to be conspecific with *E. capillare* by Naumov (1969), but other authors like Calder (1972) kept it distinct from *E. capillare* on account of its non-reduced male gonozooids. I have seen type material of this species. There are only few fragments left containing only little soft tissue. There is apparently only one type of nematocyst present like in *E. capillare* and *E. tenellum* may be regarded as synonym of *E. capillare* (see also Bulletin of Zoological nomenclature Volume 64(3), opinion 2175; on type specimen).

Working with colonies from the Gulf of Naples, Weismann (1883) and Neppi (1917) observed that their colonies had female gonozooids with some tentacles, which were nevertheless reduced in later stages. The male sporosacs had terminal nematocyst tubercles (Neppi, 1921). This prompted to Neppi (1917) to propose a variant name for this population, namely *Eudendrium capillare* var. *mediterranea*. As such a tentacle formation of the female gonozooid has also been observed in other populations (e. g. Millard, 1975; Calder, 1988; Schuchert, 2001; this study), Neppi's variant is likely not distinct from the nominal form, although the absence of information on the nematocysts precludes any reliable conclusion. Marques *et al.* (2000b) think that Neppi's variant does not belong to *E. capillare*, but the lack of information precludes a reliable identification.

Material from Greenland described in Schuchert (2001) had much less reduced female and male blastostyles. The same morphotype, or sometimes with even less reduced blastostyles, was also found at Spitsbergen (M. Ronowicz, pers. com.; MHNG INVE60719). The slight morphological differences in observed in these Arctic populations could be either due to population or environmental differences, or more likely an indicator of two separate species being involved. Genetic data from these populations are needed for a further assessment.

Eudendrium armatum Tichomiroff, 1887

Fig. 35

Eudendrium armatum Tichomiroff, 1887: 31, fig. 25, pl. 1 figs 3-4, pl. 2, figs 3-4. – Wasserthal, 1973: 93, figs 1-40. – Laukötter, 1985: 67, figs 1-15. – Boero & Fresi, 1986: 141. – Marinopoulos, 1992: 60, fig. 1.4. – Marques *et al.*, 2000a: 82, figs 16-18. – Marques *et al.*, 2000b: 202. – Puce *et al.*, 2005:202, figs 1a, 2a, 2e.

not *Eudendrium armatum* Jäderholm, 1907: 372. – Jäderholm, 1909: 52, pl 4 figs 7-9. [= *Eudendrium cnidiferum* Stechow, 1919]

MATERIAL EXAMINED: MHNG INVE39474; France, Marseille, Riou-impériaux de Terre; depth 37m; 9 July 1966; male and female colonies. – MHNG INVE29458; Greece, Island of Paros; depth 1-2m; 1 Sept. 1990; infertile colony. – MHNG INVE4987; Italy, Naples; 23 Feb. 1892, infertile. – MHNG INVE49886; Italy, Naples; collected 1896, female.

DIAGNOSIS: Colonies polysiphonic, with long nematophores replacing hydranths, male blastostyles fully developed hydranths, female blastostyles hydranths with short tentacles. Only microbasic euryteles of one size class.

DESCRIPTION: Colonies much branched, polysiphonic, tree- or bush-like. Hydranths typical for genus, basal groove near base, approximately 24 tentacles, proximal portion of tentacles devoid of nematocysts, density gradually increasing towards distal, in untidy bands, axis of capsules parallel to tentacle and thus tentacle surface not spiny. Some hydranths replaced by long, filiform, contractile nematophores, epidermis of nematophores studded densely with nematocysts, gastrodermis parenchymatic.

Male sporosacs 2-3 chambered, no terminal nematocyst button, up to 14 carried on fully developed hydranths, small minority with reduced tentacles.

Female gonophores with simple, curved spadix, up to 14 on hydranth with hypostome, somewhat smaller than usual hydranth body and short, stubby tentacles. Fertilized eggs get encapsulated and attached to pedicels of blastostyle.

Nematocysts: only one type and size of microbasic euryteles, discharged shaft shorter than capsule.

DIMENSIONS: Fertile colonies 2-8 cm high, hydranths 0.5-0.6 mm high, diameter of hydranth pedicels 0.11-0.13 mm, diameter of basal stem tubes ca. 0.18 mm. Microbasic euryteles (6-7) × (3-3.5) μm, r=2.0-2.3.

BIOLOGY: Abundant in certain regions of the Mediterranean, from 1 to 40 m, generally on rocks. Gonophores present February-March, July-October (Boero & Fresi, 1986; Marques *et al.*, 2000b).

Wasserthal (1973) described the egg, gonophore and blastostyle development in great detail. Laukötter (1985) provided the same information for males.

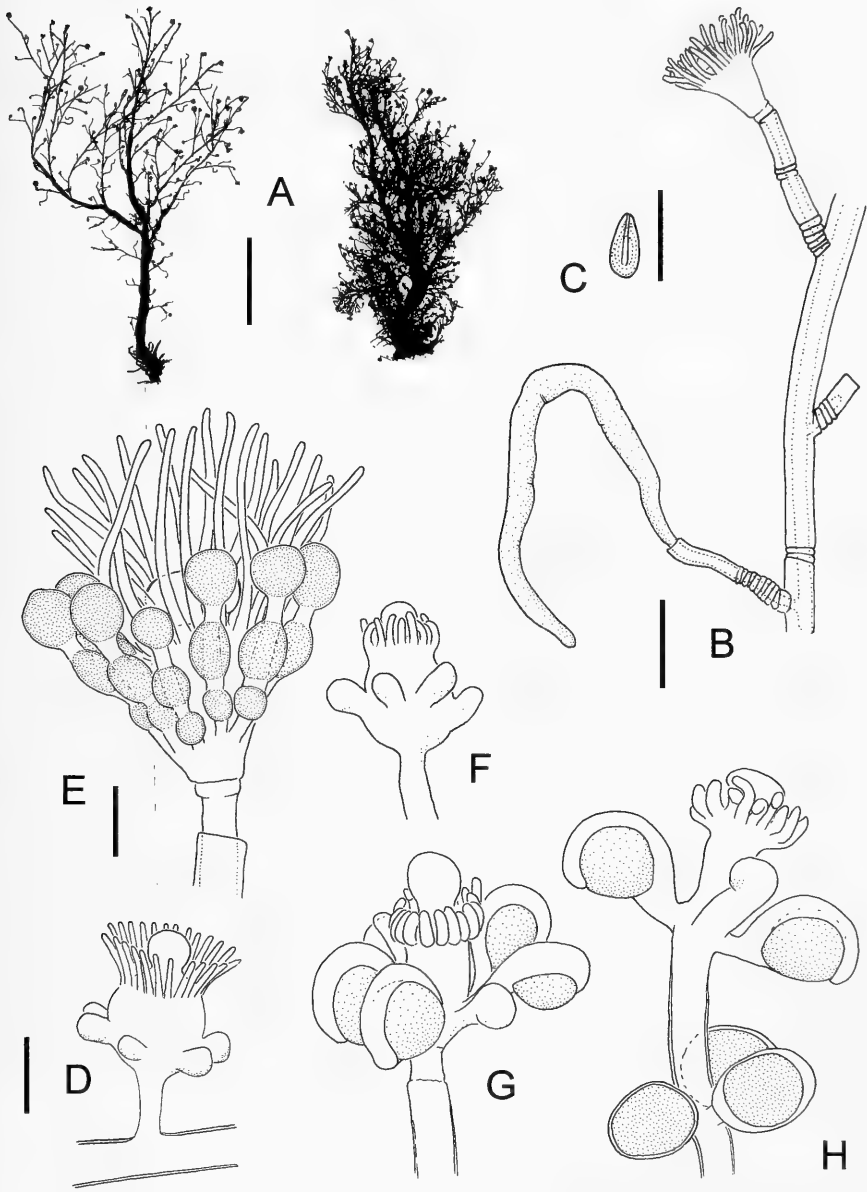


FIG. 35

Eudendrium armatum Tichomiroff, 1887, after preserved Mediterranean material. (A) Colony silhouettes illustrating variation of growth form and density, scale bar 1 cm. (B) Branch with hydranth and contracted nematophore, scale bar 0.5 mm. (C) Nematocysts: undischarged microbasic euryte, scale bar 10 μ m. (D) Young, developing male blastostyle, scale bar 0.2 mm. (E) Mature male blastostyle (intact hydranth), same scale as in D. (F) Young, developing female blastostyle, same scale as D. (G) Female blastostyle (slightly reduced hydranth) with mature eggs held by spadix; same scale as D. (H) Advanced mature female blastostyle and encapsulated embryos attached to pedicel, same scale as D.

DISTRIBUTION: Endemic to the Mediterranean, present in the western and eastern Mediterranean (Marques *et al.*, 2000b; this study). Type locality: Mediterranean.

REMARKS: Although its nematophores make it easily recognizable, *Eudendrium armatum* has likely been repeatedly confused with the similar *E. rameum*.

Eudendrium vervoorti Marques & Migotto, 1998

Fig. 36

Eudendrium vervoorti Marques & Migotto, 1998: 149, fig. 1. – Faasse & Vervoort, 2005: 60, figs 1-2.

DIAGNOSIS: Small monosiphonic colonies, female gonophores without spadix, attached via long pedicels to normal hydranths, only small microbasic euryteles of one size class.

DESCRIPTION: Colonies small, sparingly branched, monosiphonic. Perisarc mostly smooth, some indistinct rings, no clear annulation. Hydranths rather slender, no distinct basal groove, 15-20 tentacles. Female gonophores arising from body of normal hydranths, 2-6 per hydranth, without spadix, tentacles and hypostome of blastostyle not reduced during later development. Mature eggs (embryos?) encapsulated in thin perisarc, linked by long peduncles to basal part of hydranth or to hydranth-pedicel, distal part broadened. Male gonophores unknown. Nematocysts: microbasic euryteles of one size class (5.3-5.8)x(3.3-3.6) μ m, r= 1.6.

DIMENSIONS: Colonies up to 7 mm, hydranth ca. 0.57 mm high and 0.15 wide, branches 0.13 mm in diameter, eggs 0.22-0.28 mm.

BIOLOGY: Found once in a shallow seawater pool separated from the sea.

DISTRIBUTION: Type locality only, 51.633°N 03.983°E, The Netherlands, Zeeland.

REMARKS: This species is based on a single colony collected in 1962 and no further records are known. The species is rather unique among the genus *Eudendrium* as its female gonophores do not develop a spadix. In other *Eudendrium* species, a spadix is always present, but often only during the initial stages of the gonophore development. It could also be that the type material is an aberrant *E. capillare* and the absence of a spadix due to some developmental abnormalities, e. g. caused by the particular environmental conditions it was growing in. New findings must be obtained to confirm the identity of the species.

PROBLEMATIC SPECIES

Myrionema multicornis (Allman, 1876) new comb.

Perigonimus multicornis Allman, 1876: 252, pl. 9 figs 1-2. – Kramp, 1926: 241.

Eudendrium ramosum. – Kramp, 1926: 241. [not *Eudendrium ramosum* (Linnaeus, 1758)]

TYPE MATERIAL EXAMINED – Syntype, BMNH 1877.4.12.21, as *Perigonimus multicornis*, type, loc. Kattegatt, leg. G. Allman.

REMARKS: Allman (1876) based his description of *Perigonimus multicornis* on samples sent to him by Christian Frederik Lütken of the Copenhagen Museum. The specimens itself was collected by the botanist A. S. Ørsted. The provenience of the

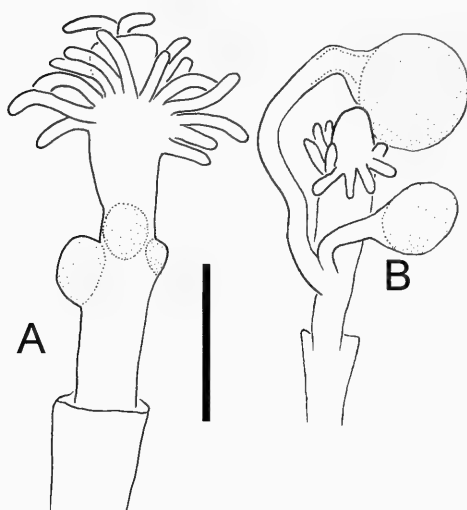


FIG. 36

Eudendrium vervoorti Marques & Migotto, 1998; modified after original publication, scale bar 0.5 mm. (A) Hydranth with putative developing eggs. (B) Hydranth with mature eggs.

sample was purportedly from the Kattegat (Denmark). Allman identified it as a new *Perigonimus* species characterized by the high number of tentacles (he gives 40 as number).

Kramp (1926) re-examined the type material in possession of the Copenhagen museum and recognized that it belonged to the Eudendriidae. He found that Allman must have mistaken hydranth-buds for incipient gonophores. True female gonophores were, however, present in the lower portion of the colony, arranged in a whorl on a normally developed hydranth. The colony was monosiphonic and Kramp thus referred it to *Eudendrium ramosum*. Kramp did not discuss the discrepancy of the tentacle number, which is much too high for *E. ramosum*.

While working at the Natural History Museum in London, I found another syntype specimen of *Perigonimus multicornis* (BMNH1877.4.12.21). It was given to the museum by Allman in 1877 and is certainly a part of the original material he had obtained from the museum in Copenhagen. An examination of these stems, growing on an unidentifiable substrate (soft tube of a polychaete?), confirmed the description of Allman, but more importantly also the observations of Kramp (1926). This specimen evidently belongs to the Eudendriidae and it even has some fertile female hydranths. The gonophores have a simple spadix and are arranged in a whorl at the base of a normally developed hydranth. The hydranths are not well preserved, likely due to pre-fixation damage by abrasion and compression, but it is evident that they are typical for the Eudendriidae. However, the large numbers of tentacles is immediately striking and they are arranged in two close-set whorls. I could find hydranths with up to 50 tentacles. An examination of the nematocysts showed that besides the usual small microbasic euryteles there are also large macrobasic euryteles. The most revealing feature, however, is the conspicuous presence of zooxanthellae in the gastrodermal

layer. The zooxanthellae are especially well visible in the tentacles and some of them still give a purple staining reaction with an iodine solution. By all means, this sample is indistinguishable from *Myrionema hargitti* (Congdon, 1906) [e. g. MHNG INVE60793 material from Guadeloupe or an unregistered sample from Belize]. The other syntype colony is still in the museum of Copenhagen and it must also be attributed to the genus *Myrionema* (Dr O. Tendal, ZMUC, pers. comm.). This makes it sure that the syntype of the London museum was not confounded with another sample after Allman had deposited it.

Allman's species is thus a senior synonym of *Myrionema hargitti*, a species that is regarded by some authors as a synonym of the Pacific *M. amboinense* Pictet, 1893 (e. g. Calder, 1988). Mainly for biogeographic reasons I think that the Caribbean *H. hargitti* should be kept distinct from the Pacific *M. amboinense*, but both species seem also to differ in the tentacle numbers. Whatsoever, hydroids of the genus *Myrionema* are confined to tropical regions and it is quite unlikely that the genus occurs along the Danish coast. It is much more probable that the origin of the type material of *M. multicornis* was given incorrectly. The collector – Anders Sandøe Ørsted (1816-1872) – was a well known Danish botanist who travelled and collected extensively in Central America and the Caribbean (e. g. Ørsted, 1863). Allman obtained the sample from Copenhagen certainly only after the death of Ørsted and it appears likely that some labels were incorrect or were confounded before he obtained it.

Until the historic presence of *Myrionema multicornis* (Allman, 1876) in the North Sea can be confirmed, it seems better to regard the type locality Kattegat of *Myrionema multicornis* as doubtful. Because the type locality is doubtful, the name *M. multicornis* should also not replace its junior synonym *Myrionema hargitti* (Congdon, 1906).

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REFERENCES

- AGASSIZ, L. 1862. Contributions to the Natural History of the United States of America. Vol. IV. *Little Brown, Boston*, pp. 1-380, pls 1-19.
- AGASSIZ, A. 1865. North American Aclephae. *Illustrated Catalogue of the Museum of Comparative Zoölogy at Harvard College* 2: 1-234.
- ALDER, J. 1856. A notice of some new genera and species of British hydroid zoophytes. *Annals and Magazine of Natural History* (2) 18: 353-362.

- ALLMAN, G. J. 1861. Notes on the hydroid zoophytes. 1. On the locomotive sexual zooid of *Dicoryne conferta*. 2. *Corymbogonium capillare*, Alder. *Annals and Magazine of Natural History* (3)8: 168-173.
- ALLMAN, G. J. 1863. Notes on the Hydroida. I. On the structure of *Corymorpha nutans*. II. Diagnoses of new species of Tubularidae obtained, during the autumn of 1862, on the coasts of Shetland and Devonshire. *Annals and Magazine of Natural History* (3)11: 1-12.
- ALLMAN, G. J. 1864. On the construction and limitation of genera among the Hydroida. *Annals and Magazine of Natural History* (3) 13: 345-380.
- ALLMAN, G. J. 1872. A monograph of the gymnoblastic or tubularian hydroids. Conclusion of Part I, and Part II, containing descriptions of the genera and species of Gymnoblastea. *Ray Society, London*, pp. 155-450, plates 1-23.
- ALLMAN, G. J. 1876. Diagnoses of new genera and species of Hydroida. *Journal of the Linnean Society of London* 12: 251-284, plates 9-23.
- ALLMAN, G. J. 1877. Report on the Hydroida collected during the Exploration of the Gulf Stream by L. F. de Pourtalès, Assistant United States Coast Survey. *Memoirs of the Museum of Comparative Zoology* 5: 1-66, plates 1-34.
- ALTUNA, P. A. 1994. Observaciones biogeograficas sobre los cnidarios bentonicos de la costa Vasca. *Kobie Ciencias Naturales* 22: 41-57.
- ARILLO, A., BAVESTRELLO, G., & BOERO, F. 1989. Circannual cycle and oxygen consumption in *Eudendrium glomeratum* (Cnidaria, Anthomedusae): studies on a shallow water population. *Marine Ecology* 10: 289-301.
- AZZINI, F., CERRANO, C., PUCE, S., & BAVESTRELLO, G. 2003. Influenza dell'ambiente sulla storia vitale di *Eudendrium racemosum* (Gmelin, 1791) (Cnidaria, Hydrozoa) in Mar Ligure. Environmental influence on the life history of *Eudendrium racemosum* (Gmelin, 1791) (Cnidaria, Hydrozoa) in the Ligurian Sea. *Biologia Marina Mediterranea* 10: 146-151.
- BARANGE, M. 1988. Prey selection and capture strategies of the benthic hydroid *Eudendrium racemosum*. *Marine Ecology Progress Series* 47: 83-88.
- BARANGE, M., & GILI, J.-M. 1988. Feeding cycles and prey capture in *Eudendrium racemosum* (Cavolini, 1785). *Journal of Experimental Marine Biology and Ecology* 115: 281-293.
- BARANGE, M., ZABALA, M., GILI, J.-M., & RIERA, T. 1987. A general approach to the 'in situ' energy budget of *Eudendrium racemosum* (Cnidaria, Hydrozoa) in the western Mediterranean. *European Marine Biology Symposium* 22:
- BAVESTRELLO, G., & PIRAINO, S. 1991. On two *Eudendrium* (Cnidaria, Hydrozoa) species from the Mediterranean Sea. *Oebalia* 17: 197-207.
- BAVESTRELLO, G., & CERRANO, C. 1992. Aggregate colonies in *Eudendrium glomeratum* Picard 1952 (Cnidaria, Hydrozoa, Anthomedusae). *Scientia Marina* 56: 333-335.
- BAVESTRELLO, G., CERRANO, C., & CATTANEO, V. R. 1994. Colonies of *Eudendrium glomeratum* (Cnidaria, Hydromedusae) as sediment traps on vertical rocky cliffs. *Bollettino dei Musei e Degli Istituti Biologici dell'università di Genova* 58-59 (1992-1993): 125-130.
- BEDOT, M. 1914. Nouvelles notes sur les hydroïdes de Roscoff. *Archives de Zoologie Expérimentale et Générale* 54: 79-98, pl. 5.
- BERRILL, N. J. 1952. Growth and form in gymnoblastic hydroids. II. Sexual and seasonal reproduction in *Rathkea*. III. Hydranth and gonophore development in *Pennaria* and *Acaulis*. IV. Relative growth in *Eudendrium*. *Journal of Morphology* 90: 1-32.
- BÉTENCOURT, A. 1899. Deuxième liste des hydraïres du Pas-de-Calais. In: Miscellanées biologiques dédiées an Professeur Alfred Giard. *Travaux de la Station zoologique de Wimereux* 7: 1-13, planche 1.
- BILLARD, A. 1904. Contribution à l'étude des Hydroïdes (multiplication, régénération, greffes, variations). *Annales des Sciences Naturelles, Zoologie et Paléontologie* 20 (8): 1-251.
- BILLARD, A. 1926. Rapport sur les hydroïdes. In: Cambridge Expedition to the Suez Canal (with appendix to the report on hydroids by H. Munro Fox and an addendum). *Transactions of the Zoological Society of London* 22: 85-104.

- BILLARD, A. 1927. Les hydroïdes de la côte atlantique de France. *Comptes rendus du Congrès des sociétés savantes de Paris et des départements; section des sciences* 1926: 326-346.
- BOERO, F. 1981. Systematics and ecology of the hydroid population of two *Posidonia oceanica* Meadows. *Marine Ecology* 2: 181-197.
- BOERO, F. 1984. The ecology of marine hydroids and effects of environmental factors: a review. *Marine Ecology* 5: 93-118.
- BOERO, F., & CORNELIUS, P. F. S. 1987. First records of *Eudendrium glomeratum* (Cnidaria: Hydroida) in British and Irish waters, and taxonomic comments. *Irish Naturalists' Journal* 22: 244-246.
- BOERO, F., BALDUZZI, A., BAVESTRELLO, G., CAFFA, B., & CATTANEO-VIETTI, R. 1986. Population dynamics of *Eudendrium glomeratum* (Cnidaria: Anthomedusae) on the Portofino Promontory (Ligurian Sea). *Marine Biology* 92: 81-85.
- BOERO, F., & FRESI, E. 1986. Zonation and evolution of a rocky bottom hydroid community. *Marine Ecology* 7: 123-150.
- BONNEVIE, K. 1898a. Zur Systematik der Hydroiden. *Zeitschrift für Wissenschaftliche Zoologie* 63: 465-495, plates 25-27.
- BONNEVIE, K. 1898b. Neue norwegische Hydroiden. *Bergens Museum Årbok* 5: 1-16, plates 1-2.
- BONNEVIE, K. 1899. Hydroida. *Norske Nordhavs-Expedition 1876-1878, Zoologi* 26: 1-104, pls. 1-8, map.
- BOUILLON, J., MASSIN, C., & KRESEVIC, R. 1995. Hydroidomedusae of the Belgian Royal Society of Natural Sciences. *Institut Royal des Sciences Naturelles de Belgique, Documents de Travail* 78: 1-106.
- BOUILLON, J., GRAVILLI, C., PAGÈS, F., GILI, J.-M., & BOERO, F. 2006. An introduction to Hydrozoa. *Mémoires du Muséum national d'Histoire naturelle* 194: 1-591.
- BOUILLON, J., MEDEL, M. D., PAGÈS, F., GILI, J. M., BOERO, B., & GRAVILLI, C. 2004. Fauna of the Mediterranean Hydrozoa. *Scientia Marina* 68 (Suppl. 2): 1-448.
- BRIGGS, E. A. 1922. Description of the coppinia of an Australian hydroid. *Australian Zoologist* 2: 148-150.
- BROCH, H. 1910. Die Hydroiden der Arktischen Meere. *Fauna Arctica* 5: 127-248, plates 2-4.
- BROCH, H. 1916. Hydroida. (Part I). *Danish Ingolf Expedition* 5: 1-66.
- BROCH, H. 1928. Hydrozoen. In: Fr. Dahl [ed.], *Die Tierwelt Deutschland und der angrenzenden Meeresteile nach ihren Merkmalen und nach ihrer Lebensweise*, 4: 95-160, figs. 1-62.
- BROWNE, E. T. 1897. The hydroids of Valencia Harbour, Ireland. *Irish Naturalist* 6: 241-246.
- BUCHANAN, J. B. 1956. Contributions to the hydroid fauna of the Cameroons. *Revue de zoologie et de botanique africaines* 53: 276-280.
- BUCHANAN, J. B. 1957. The hydroid fauna of the Gold Coast. *Revue de zoologie et de botanique africaines* 56: 349-372.
- CALDER, D. R. 1971. Hydroids and hydromedusae of southern Chesapeake Bay. *Virginia Institute of Marine Science. Special Papers in marine Science* 1: 1-125.
- CALDER, D. R. 1972. Some athecate hydroids from the shelf waters of northern Canada. *Journal of the Fisheries Research Board of Canada* 29: 217-228.
- CALDER, D. R. 1976. The zonation of hydroids along salinity gradients in South Carolina estuaries. In: G.O. MACKIE, ed., *Coelenterate Ecology and Behavior*: 165-174, figs. 1-3, tab. 1. Plenum Publishing Corporation, N.Y.
- CALDER, D. R. 1988. Shallow-water hydroids of Bermuda. The Athecatae. *Royal Ontario Museum Life Sciences Contributions* 148: 1-107.
- CALDER, D. R. 1990. Seasonal cycles of activity and inactivity in some hydroids from Virginia and South Carolina, U.S.A. *Canadian Journal of Zoology* 68: 442-450.
- CALDER, D. R. 2003. Subtidal hydroids (Cnidaria) of Northumberland Strait, Atlantic Canada, with observations on their life cycles and distributions. *Canadian Field Naturalist* 117: 555-564.

- CALDER, D. R., & VERVOORT, W. 1998. Some hydroids (Cnidaria: Hydrozoa) from the Mid-Atlantic Ridge, in the North Atlantic Ocean. *Zoologische Verhandlungen* 319: 1-65.
- CASTRIC, A., & MICHEL, C. 1982. Flore et faune fixées sous marines de Bretagne. *Laboratoire maritime, Concarneau*, pp. 1-96.
- CASTRIC, A., GIRARD, A., & MICHEL, C. 1987. Roches sous marines de Bretagne : flore et faune fixée. CNRS Laboratoire de biologie marine, Concarneau, 4th edition, 116 pp.
- CASTRIC-FEY, A., GIRARD-DESCATOIRE, A., L'HARDY-HALOS, M.-T., & DERRIEN-COURTEL, S. 2001. La vie sous-marine en Bretagne – Découverte des fonds rocheux. *Conseil Régional de Bretagne, Biotope édit.*, pp. 176.
- CAVOLINI, F. 1785. Memorie per servire alla storia de 'Polipi marini'. *Naples*, pp. 279.
- CHRISTIANSEN, B. O. 1972. The hydroid fauna of the Oslo Fjord in Norway. *Norwegian Journal of Zoology* 20: 279-310.
- CLARKE, S. F. 1882. New and interesting hydroids from Chesapeake Bay. *Memoirs of the Boston Society of Natural History* 3: 135-142, pls 7-9.
- CONGDON, E. D. 1906. Notes on the morphology and development of two species of *Eudendrium*. *Biological Bulletin of the Marine Biological Laboratory / Woods Hole* 11: 27-46.
- CORNELIUS, P. F. S., & GARFATH, J. B. 1980. The coelenterate taxa of Joshua Alder. *Bulletin of the British Museum* 39: 273-291.
- COSTELLO, M. J., EMBLOW, C. & WHITE R. (editors) 2001. European Register of Marine Species. A check-list of marine species in Europe and a bibliography of guides to their identification. *Patrimoines naturels* 50: 1-463. Available online at: <http://www.MarBEF.org/data/erms.php>.
- DA CUNHA, A. X. 1944. Hidropólipos das costas de Portugal. *Memorias e Estudos de Museu Zoologico da Universidade de Coimbra* 161: 1-101.
- DE VITO, D., BOERO, F., DI CAMILLO, C.G., MEGINA C., & PIRAINO, S. 2008. Redescription of the zooxanthellate *Eudendrium moulouyensis* Marques, Peña Cantero, Vervoort 2000 (Eudendriidae, Hydrozoa) from the Mediterranean Sea. *Journal of the Marine Biological Association of the United Kingdom* (in press).
- DEEVEY, E. S. 1954. Hydroids of the western Gulf of Mexico. In: GALTISOFF P.S., ed., Gulf of Mexico. Its origin, waters, and marine life. *Fishery Bulletin / Fish and Wildlife Service, United States Department of the Interior* 55: 267-272.
- D'ORBIGNY, A. D. 1846. Zoophytes. Pp. 17-28. In: Voyage dans l'Amerique Méridionale...exécuté pendant... 1826-33. Volume 5 (4). *Pitois-Levrault, Paris*.
- EHRENBERG, C. G. 1834. Beiträge zur physiologischen Kenntniss der Corallenthiere im allgemeinen, und besonders des rothen Meeres, nebst einem Versuche zur physiologischen Systematik derselben. *Abhandlungen der Königlichen Akademie der Wissenschaften, Berlin* 1: 225-380.
- ELLIS, J. 1755. An essay towards a natural history of the Corallines, and other marine productions of the like kind, commonly found on the coasts of Great Britain and Ireland : to which *fishers, in the summer 1753. *London*, pp. i-xxviii, 1-104, pls. 1-37.
- FAASSE, M., & VERVOORT, W. 2005. Autochtone soorten van het geslacht *Eudendrium* Ehrenberg, 1834 (Hydrozoa: Anthoathecata) in het deltagebied. *Zeepaard* 65: 55-66.
- FEY, A. 1970. Peuplements sessiles de l'archipel de Glénan. 1.- Inventaire: hydriques. *Vie & Milieu* 20B: 387-413.
- FRASER, C. M. 1912. Some hydroids of Beaufort, North Carolina. *Bulletin of the United States Bureau of Fisheries* 30: 337-387.
- FRASER, C. M. 1937. Hydroids of the Pacific coast of Canada and the United States. *The University of Toronto Press, Toronto*, pp. 208, pls 1-44.
- FRASER, C. M. 1939. Distribution of the hydroids in the collections of the Allan Hancock Expeditions. *Allan Hancock Pacific Expeditions* 4: 155-178.

- FRASER, C. M. 1944. Hydroids of the Atlantic coast of North America. *The University of Toronto Press, Toronto*, pp. 1-451, pls 1-94.
- FRASER, C. M. 1948. Hydroids of the Allan Hancock Pacific Expeditions since March, 1938. *Allan Hancock Pacific Expeditions* 4: 179-343.
- GILI, J.-M. 1982. Fauna de cnidaris de les illes Medes. *Treballs de la Institucio Catalana d'Historia Natural* 10: 1-175.
- GILI, J.-M., & CASTELLO, G. 1985. Hidropolipos de la costa norte del Cabo de Creus (N.E. Catalunya). *Miscellanea Zoologica* 9: 7-24.
- GILI, J. M., & GARCIA RUBIES, A. 1985. Contribution a la connaissance de la faune d'hydropolipes de l'île de Majorque. *Anales de Biologia* 3: 37-53.
- GILI, J.-M., & ROS, J.-D. 1985. Estudio cuantitativo de tres poblaciones circalitorales de cnidarios bentonicos. *Investigacion Pesquera* 49: 323-352.
- GMELIN, J. F. 1788. Caroli a Linné ... Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis / cura Jo. Frid. Gmelin. Tom. 1, Pars. 6. *Impensis Georg. Emanuel. Beer, Lipsiae*, pp. 3021-3909.
- GUINDON, S & GASCUEL, O. 2003. A simple, fast, and accurate algorithm to estimate large phylogenies by maximum likelihood. *Systematic Biology* 52(5): 696-704.
- HAMOND, R. 1957. Notes on the Hydrozoa of the Norfolk coast. *Journal of the Linnean Society of London* 43: 294-324.
- HANISCH, J. 1970. Die Blastostyle- und Spermienentwicklung von *Eudendrium racemosum* Cavolini. *Zoologische Jahrbücher, Abteilung für Anatomie und Ontogenie der Tiere* 87: 1-62.
- HARTLAUB, C. 1905. Die Hydroiden der magalhaenischen Region und der chilenischen Küste. *Zoologische Jahrbücher, Supplement Band* 6: 497-714.
- HINCKS, T. 1861. A catalogue of the zoophytes of South Devon and South Cornwall. *Annals and Magazine of Natural History* (3)8: 152-161, 251-262, 290-297, pls 6-8.
- HINCKS, T. 1868. A history of the British hydroid zoophytes. *John van Voorst, London*, pp. Volume 1: i-ixvii + 1-338, volume 2, pls 1-67.
- HIROHITO EMPEROR OF JAPAN 1988. The hydroids of Sagami Bay collected by His Majesty the Emperor of Japan. *Biological Laboratory of the Imperial Household, Tokyo*, pp. 179, plates 1-4.
- INTERNATIONAL COMMISSION OF ZOOLOGICAL NOMENCLATURE, 2000. *Eudendrium arbuscula* Wright, 1859 (Cnidaria, Hydrozoa): specific name conserved. *Bulletin of Zoological Nomenclature* 57: 180-181.
- ISHIKAWA, C. 1887. Ueber die Abstammung der männlichen Geschlechtszellen bei *Eudendrium racemosum* Cav. *Zeitschrift für wissenschaftliche Zoologie* 45: 669-671.
- JÄDERHOLM, E. 1907. Über einige nordische Hydroiden. *Zoologischer Anzeiger* 32: 371-376.
- JÄDERHOLM, E. 1908. Die Hydroiden des sibirischen Eismeer, gesammelt von der Russischen Polar-Expedition 1900-1903. *Mémoires de l'Académie des Sciences de St.-Petersbourg* 18: 1-26, plates.
- JÄDERHOLM, E. 1909. Northern and arctic invertebrates in the collection of the Swedish state museum (Riksmuseum). IV Hydroiden. *Bihang till Kungliga Svenska Vetenskapsakademiens Handlingar* 45: 1-24.
- JÄDERHOLM, E. 1916. Hydroiden. In: Results of Dr. Mjöberg's Swedish scientific expeditions to Australia 1910-1913, XII. *Kungliga Svenska Vetenskapsakademiens Handlingar* 52: 1-9.
- KINGSLEY, J. S. 1910. A synopsis of the fixed hydroids of New England. *Tufts College Studies (Scientific Series)* 3: 13-38.
- KIRKPATRICK, R. 1910. Hydrozoa and Porifera. In: J.T. Cunningham, On the marine fishes and invertebrates of St. Helena. *Proceedings of the zoological Society of London* 1910: 127-130, pl. 7.
- KRAMP, P. L. 1914. Hydroider. Conspectus Faunae Groenlandicae. *Meddelelser om Grønland* 23: 953-1080.

- KRAMP, P. L. 1926. Occasional notes on Coelenterata. 1. *Videnskabelige meddelelser fra Dansk naturhistorisk Forening* 82: 241-247.
- KRAMP, P. L. 1932a. Hydroids. In: The Godthaab expedition 1928. *Meddelelser om Grønland* 79: 1-86.
- KRAMP, P. L. 1932b. Hydroids collected in the West-Greenland Fjords in 1911 and 1912. *Meddelelser om Grønland* 91: 1-35.
- KRAMP, P. L. 1939. Occasional notes on Coelenterata. III. *Videnskabelige meddelelser fra Dansk naturhistorisk Forening* 103: 503-516.
- KUBOTA, S. 1976. Notes on the Nematocysts of Japanese Hydroids, I. *Journal of the Faculty of science of the Hokkaido University, Series VI, Zoology* 20: 230-243.
- LAUKÖTTER, G. 1985. Bau und Entwicklung der männlichen Keimzelltrager von *Eudendrium armatum* Tichmiroff (Cnidaria, Hydrozoa, Hydroidea, Athecata). *Zoologische Jahrbücher Abteilung für Anatomie und Ontogenie der Tiere* 113: 67-76.
- LELOUP, E. 1937. Hydropolypes et scyphopolypes recueillis par C. Dawydoff sur les côtes de l'Indochine française. *Bulletin du Musée Royal d'Histoire Naturelle de Belgique* 12: 1-73.
- LELOUP, E. 1939. Notes sur quelques hydropolypes exotiques. *Bulletin du Musée Royal d'Histoire naturelle de Belgique* 15: 1-19.
- LELOUP, E. 1940. Hydropolypes provenant des croisières du Prince Albert Ier de Monaco. *Résultats des Campagnes Scientifiques Accomplies sur son Yacht par Albert Ier, Prince Souverain de Monaco* 104: 1-38.
- LELOUP, E. 1947. Les Coelentérés de la faune Belge. Leur bibliographie et leur distribution. *Mémoires du Musée royal d'histoire naturelle de Belgique* 107: 1-73.
- LELOUP, E. 1952. Coelentérés. pp. 283. In: *Faune de Belgique* Institut Royal des Sciences naturelles, Bruxelles, Belgium.
- LENDENFELD, R. VON 1885. The Australian Hydromedusae. *Proceedings of the Linnean Society of New South Wales* 9: 206-241; 345-353; 401-420; 467-492; 581-634.
- LEVINSEN, G. M. R. 1893. Meduser, Ctenophorer og Hydroider fra Grønlands Vestkyst, tilligemed Bemaerkninger om Hydroidernes Systematik. *Videnskabelige Meddelelser fra Dansk naturhistorisk Forening i København* 4: 143-212, 215-220, appendix, plates 5-8.
- LINNAEUS, C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera, species cum characteribus, differentiis, synonymis, locis. Edition decima, reformata. *Laurentii Salvii, Holmiae*, pp. 823.
- MANEA, V. 1977. Cercetari asupra hidrozozorelor din Mrea Neagr litoralul romanesc. *Studii si comunicari, Muzeul de Stiinte Naturii Bacau. Biologie animala* 9: 43-54.
- MARINOPULOS, J. 1992. Taxonomy and phylogeny of the Mediterranean *Eudendrium* (Hydrozoa, Hydroida). *Bulletin de l'Institut océanographique spec. vol* 9: 53-66.
- MARQUES, A. C. 1995. *Eudendrium pocaruquarum* n. sp. (Hydrozoa, Eudendriidae) from the southeastern coast of Brazil, with remarks on taxonomic approaches to the family Eudendriidae. *Bijdragen Tot de Dierkunde* 65: 35-40.
- MARQUES, A. C., & MIGOTTO, A. E. 1998. A new species of *Eudendrium* (Hydrozoa: Anthomedusae: Eudendriidae) from the Netherlands. *Zoologische Verhandelingen* 323: 149-154.
- MARQUES, A. C., & VERVOORT, W. 1999. Case 3074. *Eudendrium arbuscula* Wright, 1859 (Cnidaria, Hydrozoa): proposed conservation of the specific name. *Bulletin of Zoological Nomenclature* 56: 16-18.
- MARQUES, A. C., MERGNER, H., HOINGHAUS, R., SANTOS, C. M. D., & VERVOORT, W. 2000a. Morphological study and taxonomical notes on Eudendriidae (Cnidaria: Hydrozoa: Athecatae/Anthomedusae). *Zoologische Mededelingen* 74: 75-118.
- MARQUES, A. C., PENA CANTERO, A. L., & VERVOORT, W. 2000b. Mediterranean species of *Eudendrium* Ehrenberg, 1834 (Hydrozoa, Anthomedusae, Eudendriidae) with the description of a new species. *Journal of Zoology* 252: 197-213.

- MARTIN, R. 2003. Management of nematocysts in the alimentary tract and in cnidosacs of the aeolid nudibranch gastropod *Cratena peregrina*. *Marine Biology* 143: 533-541.
- MARTIN, R., & WALTHER, P. 2002. Effects of discharging nematocysts when an aeolid nudibranch feeds on a hydroid. *Journal of the Marine Biological Association of the United Kingdom* 82: 455-462.
- MARTIN, R., & WALTHER, P. 2003. Protective mechanisms against the action of nematocysts in the epidermis of *Cratena peregrina* and *Flabellina affinis* (Gastropoda, Nudibranchia). *Zoomorphology* 122: 25-35.
- MCDUGALL, K. D. 1943. Sessile marine Invertebrates at Beaufort, North Carolina. A study of settlement, growth and seasonal fluctuations among pile dwelling organisms. *Ecological Monographs* 13: 321-374.
- MEDEL, D., & LOPEZ GONZALEZ, P. J. 1996. Updated catalogue of hydrozoans of the Iberian Peninsula and Balearic Islands, with remarks on zoogeography and affinities. *Scientia Marina* 60: 183-209.
- MERGNER, H. 1957. Die Ei- und Embryonalentwicklung von *Eudendrium racemosum* Cavolini. *Zoologische Jahrbücher, Abteilung für Anatomie und Ontogenie der Tiere* 76: 63-164.
- MILLARD, N. A. H. 1959. Hydrozoa from the coasts of Natal and Portuguese East Africa. Part II. Gymnoblastera. *Annals of the South African Museum* 44: 297-313.
- MILLARD, N. A. H. 1975. Monograph on the Hydrozoa of southern Africa. *Annals of the South African Museum* 68: 1-513.
- MILLARD, N. A. H. 1977. Hydroids from the Kerguelen and Crozet shelves collected by the cruise MD.03 of the Marion-Dufresne. *Annals of the South African Museum* 73: 1-47.
- MILLARD, N. A. H., & BOUILLON, J. 1973. Hydroids from the Seychelles (Coelenterata). *Annales du Musée Royal de l'Afrique Centrale, série In-8°, Sciences Zoologiques* 206: 1-106, pls 1-5.
- MILLARD, N. A. H., & BOUILLON, J. 1974. A collection of hydroids from Mocambique, East Africa. *Annals of the South African Museum* 65: 1-40.
- MORRI, C. 1981. Idrozoi lagunari. *Consiglio Nazionale delle Ricerche, Genova*, pp. 105.
- MORRI, C., BAVESTRELLO, G., & BIANCHI, C. N. 1991. Faunal and ecological notes on some benthic cnidarian species from the Tuscan Archipelago and eastern Ligurian Sea (western Mediterranean). *Bollettino dei Musei e degli Istituti Biologici dell' Università di Genova* 54-55: 27-47.
- MOTZ-KOSSOWSKA, S. 1905. Contribution à la connaissance des hydraires de la Méditerranée occidentale. I. Hydraires gymnoblastiques. *Archives de Zoologie Expérimentale et générale, 4me série* 3: 39-98.
- MOURA, C. J., HARRIS, D. J., CUNHA M. R. & ROGERS, A. D. 2008. DNA barcoding reveals cryptic diversity in marine hydroids (Cnidaria, Hydrozoa) from coastal and deep-sea environments. *Zoologica Scripta* 37:93-108.
- NAUMOV, D. V. 1969. Hydroids and Hydromedusae of the USSR. *Israel Program for scientific translation, Jerusalem*, pp. 463, 30 plates.
- NEPPI, V. 1917. Osservazioni sui polipi idroidi del golfo di Napoli. *Pubblicazioni della Stazione Zoologica di Napoli* 2: 29-65.
- NEPPI, V. 1921. Nuove osservazioni sui polipi idroidi del Golfo di Napoli. *Pubblicazioni della Stazione Zoologica di Napoli* 3: 1-31.
- NORMAN, A. M. 1864. On undescribed British Hydrozoa, Actinozoa, and Polyzoa. *Annals and Magazine of Natural History* (3)13: 82-90.
- NORMAN, A. M. 1869. Shetland final dredging report, P. II. On the Crustacea, Tunicata, Echinodermata, Actinozoa, Hydrozoa, and Porifera. *Report of the 38th Meeting of the British Association for the Advancement of Science (Norwich, 1868)* 38: 247-336.
- NUTTING, C. C. 1896. Notes on Plymouth Hydroids. *Journal of the Marine Biological Association of the U. K.* n. ser. 4: 146-154.
- NUTTING, C. C. 1898. On three new species of hydroids and one new to Britain. *Annals and Magazine of Natural History* (7) 1: 362-366.

- NUTTING, C. C. 1901. The Hydroids of the Woods Hole region. *Bulletin of the U. S. Fish Commission for 1899*: 325-386.
- OKEN, L. 1815. *Okens Lehrbuch der Naturgeschichte. Dritter Theil. Zoologie. Jena*, pp. xxviii, 842, xviii, ivp : 40 pls.
- ØRSTED, A. S. 1863. L'Amérique Centrale: Recherches sur sa flora et sa géographie physique. *Copenhague, Bianco Luno*.
- PALLAS, P. A. 1766. Elenchus zoophytorum sistens generum adumbrationes generaliores et specierum cognitarum succinctas descriptiones cum selectis auctorum synonymis. *Fransiscum Varrentrapp, Hagee*, pp. 451.
- PALOMBI, A. 1940. Studi sugli Idroidi. L'azione delle radiazioni luminose. *Bollettino della Società dei Naturalisti in Napoli* 50: 149-182.
- PARK, J. H. 1991. Systematic study on the marine hydroids (Cnidaria: Hydrozoa) in Korea. 2. The families Sphaerocorynidae, Eudendriidae, Haleciidae and Lafoeidae. *Korean Journal of Zoology* 34: 541-547.
- PEÑA CANTERO, A. L., & GARCIA CARRASCOSA, A. M. 2002. The benthic hydroid fauna of the Chafarinas Islands (Alboran Sea, western Mediterranean). *Zoologische Verhandelingen* 337: 1-180.
- PENNYCUK, P. R. 1959. Faunistic record from Queensland. Part V. Marine and Brackish Water Hydroids. *Papers of the department of zoology of the university of Queensland* 1: 141-210.
- PHILBERT, M. 1935. Les hydraires de la région malouine. *Bulletin de l'Institut Océanographique, Monaco* 673: 1-36.
- PICARD, J. 1951a. Hydraires littoraux du Sénégal récoltés par H. Sourie aux environs de Dakar. *Bulletin de l'Institut français d'Afrique noire* 13: 109-115.
- PICARD, J. 1951b. Les hydraires des formations coralligènes des côtes françaises de la Méditerranée. *Vie et Milieu* 2: 255-261.
- PICARD, J. 1952. Note sur les hydraires littoraux de Banyuls-sur-Mer. *Vie et Milieu* 2: 338-349.
- PICARD, J. 1955. Hydraires des environs de Castiglione (Algérie). *Bulletin des travaux publiés par la Station d'aquiculture et de pêche de Castiglione. Nouvelle série* 7: 177-199.
- PICARD, J. 1958. Origines et affinités de la faune d'hydropolypes (Gymnoblastes et Calyptoblastes) et d'hydroméduses (Anthomédues et Leptomédues) de la Méditerranée. *Rapports et procès verbaux des Réunions de la Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée Monaco* 14: 187-199.
- PICTET, C. 1893. Etude sur les hydraires de la Baie d'Amboine. *Revue suisse de Zoologie* 1: 1-64.
- PIEPER, F. W. 1884. Ergänzungen zu Heller's "Zoophyten etc. des adriatischen Meeres". *Zoologischer Anzeiger* 7: 148-152, 164-169, 185-188, 216-221.
- PUCE, S., BAVESTRELLO, G., ARILLO, A., AZZINI, F., & CERRANO, C. 2002. Morpho-functional adaptation to suspension feeding in *Eudendrium* (Cnidaria, Hydrozoa). *Italian Journal of Zoology* 69: 301-304.
- PUCE, S., CERRANO, C., DI CAMILLO, C., BAVESTRELLO, G., & MARQUES, A. C. 2006. *Eudendrium* (Cnidaria: Hydrozoa) from Bunaken Marine Park, Sulawesi Sea, Indonesia. *Zoological Studies* 45: 616-625.
- PUCE, S., TAZIOLI, S., & BAVESTRELLO, G. 2005. Nematocyst arrangement on the tentacles of the polyps of *Eudendrium* (Cnidaria, Hydrozoa). *Italian Journal of Zoology Modena* 72: 201-204.
- RAMIL, F., & VERVOORT, W. 1992. Report on the Hydroida collected by the 'BALGIM' expedition in and around the Strait of Gibraltar. *Zoologische Verhandelingen* 277: 1-262.
- REES, W. J. 1952. Records of hydroids and medusae taken at Herdla, Bergen in 1937. *Naturvidenskabelige Raekke, Årbok Universitet i Bergen* 16: 1-8, tab. 1.
- REES, W. J., & ROWE, M. 1969. Hydroids of the Swedish west coast. *Acta regiae Societatis scientiarum et litterarum Gothoburgensis. Zoologica* 3: 1-23.

- RUSSELL, F. S. 1957. Coelenterata. pp. 37-69. In: Plymouth marine fauna, pp. 457. *Marine Biological Association of the United Kingdom, Plymouth*.
- SCHNEIDER, K. C. 1898. Hydropolypen von Rovigno, nebst Uebersicht über das System der Hydropolypen im Allgemeinen. *Zoologische Jahrbücher, Abteilung für Systematik, Geographie und Biologie der Thiere* 10: 472-555.
- SCHUCHERT, P. 1996. The marine fauna of New Zealand: athecate hydroids and their medusae (Cnidaria: Hydrozoa). *New Zealand Oceanographic Institute Memoir* 106: 1-159.
- SCHUCHERT, P. 2000. Hydrozoa (Cnidaria) of Iceland collected by the BIOICE programme. *Sarsia* 85: 411-438.
- SCHUCHERT, P. 2001. Hydroids of Greenland and Iceland (Cnidaria, Hydrozoa). *Meddelelser om Grønland, Bioscience* 53: 1-184.
- SCHUCHERT, P. 2004. Revision of the European athecate hydroids and their medusae (Hydrozoa, Cnidaria): Families Oceanidae and Pachycordylidae. *Revue suisse de Zoologie* 111: 315-369.
- SCHUCHERT, P. 2005. Species boundaries in the hydrozoan genus *Coryne*. *Molecular Phylogenetics and Evolution* 36: 194-199.
- SCHUCHERT, P. 2006. The European athecate hydroids and their medusae (Hydrozoa, Cnidaria): Capitata part 1. *Revue suisse de Zoologie* 113: 325-410.
- SCHUCHERT, P. 2007. The European athecate hydroids and their medusae (Hydrozoa, Cnidaria): Filifera Part 2. *Revue suisse de Zoologie* 114: 195-396.
- SCHUCHERT, P. 2008. The European athecate hydroids and their medusae (Hydrozoa, Cnidaria): Filifera Part 3. *Revue suisse de Zoologie* 115: 221-302.
- SOMMER, C. 1990. Post-embryonic larval development and metamorphosis of the hydroid *Eudendrium racemosum* (Cavolini) (Hydrozoa, Cnidaria). *Helgoländer Meeresuntersuchungen* 44: 425-444.
- SOMMER, C. 1992. Larval biology and dispersal of *Eudendrium racemosum* (Hydrozoa, Eudendriidae). *Scientia Marina* 56: 205-211.
- STECHOW, E. 1913. Hydroidpolypen der japanischen Ostküste. II. Teil: Campanularidae, Halecidae, Lafoeidae, Campanulinidae und Sertularidae, nebst Ergänzungen zu den Athecata und Plumularidae. In: F. Doflein, Beiträge zur Naturgeschichte Ostasiens. *Abhandlungen der Mathematisch-Physikalische Klasse der Königlichen Bayerischen Akademie der Wissenschaften, Supplement Band 3*: 1-162.
- STECHOW, E. 1919. Zur Kenntnis der Hydroidenfauna des Mittelmeeres, Amerikas und anderer Gebiete, nebst Angaben über einige Kirchenpauer'sche Typen von Plumulariden. *Zoologische Jahrbücher, Abteilung für Systematik, Geographie und Biologie der Tiere* 42: 1-172.
- STECHOW, E. 1921. Neue Genera und Species von Hydrozoen und anderen Evertebraten. *Archiv für Naturgeschichte* 87: 248-265.
- STECHOW, E. 1923. Zur Kenntnis der Hydroidenfauna des Mittelmeeres, Amerikas und anderer Gebiete. II. Teil. *Zoologische Jahrbücher, Abteilung für Systematik, Geographie und Biologie der Tiere* 47: 29-270.
- STECHOW, E. 1924. Diagnosen neuer Hydroiden aus Australien. *Zoologischer Anzeiger* 59: 57-69.
- SUMMERS, R. G. 1972. An ultrastructural study of the spermatozoa of *Eudendrium ramosum*. *Zeitschrift für Zellforschung und mikroskopische Anatomie* 132: 147-166.
- TEISSIER, G. 1965. Inventaire de la faune marine de Roscoff. Cnidaires-Cténaires. *Travaux de la Station Biologique de Roscoff* 16: 1-53.
- THOMPSON, M. T. 1899. The breeding of animals at Woods Hole during the month of September 1898. *Science, N.Y.* n. ser. 9: 581-583.
- THORNELLY, L. A. 1904. Report on the Hydroida collected by professor Herdman, at Ceylon, in 1902. *Report to the Government of Ceylon on the pearl oyster fisheries of the Gulf of Manaar* 2, no. suppl. Rep. 8: 107-126.

- TICHOMIROFF, A. A. 1887. K istorii razvitiya gidroidov [in Russian: Contribution to the history of the development of the hydroids]. *Bulletin of the Moscow Society of Naturalists* 50 (append. 1): 1-69, pls. 1-2.
- VAN BENEDEN, P. J. 1844. Recherches sur l'embryogénie des tubulaires, et l'histoire naturelle des différents genres de cette famille qui habitent la Côte d'Ostende. *Nouveaux Mémoires de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles* 17: 1-72.
- VANNUCCI, M. 1954. Hidrozoo e Scyphozoo existentes no Instituto Oceanográfico. II. *Boletim do Instituto Oceanográfico de São Paulo* 5: 95-149, pls. 1-6.
- VERVOORT, W. 1946. Hydrozoa (C 1) A. Hydropolypen. *Fauna van Nederland* 14: 1-336.
- VERVOORT, W. 1968. Report on a collection of Hydroida from the Caribbean region, including an annotated checklist of Caribbean hydroids. *Zoologische Verhandelingen, Leiden* 92: 1-124.
- VERVOORT, W. 2006. Leptolida (Cnidaria: Hydrozoa) collected during the CANCAP and Mauritania-II expeditions of the National Museum of Natural History, Leiden, the Netherlands (Anthoathecata, various families of Leptothecata and addenda). CANCAP-project. Contributions, no. 128. *Zoologische Mededelingen Leiden* 80: 181-318.
- WARREN, E. 1908. On a collection of hydroids, mostly from the Natal coast. *Annales of the Natal Museum* 1: 269-355.
- WASSERTHAL, W. 1973. Zur Ei- und Embryonalentwicklung des Hydroidpolypen *Eudendrium armatum*. Eine licht- und elektronenmikroskopische Untersuchung. *Helgoländer wissenschaftliche Meeresuntersuchungen* 25: 93-125.
- WATSON, J. E. 1985. The genus *Eudendrium* (Hydrozoa: Hydroida) from Australia. *Proceedings of the Royal Society of Victoria* 97: 179-221.
- WATSON, J. E. 1999. Hydroids (Hydrozoa: Anthoathecata) from the Beagle Gulf and Darwin Harbour, northern Australia. *The Beagle, Records of the Museums and Art Galleries of the Northern Territory* 15: 1-21.
- WEDLER, E. 1975. Oekologische Untersuchungen an Hydroiden des Felslitorals von Santa Marta (Kolumbien). *Helgoländer wissenschaftliche Meeresuntersuchungen* 27: 324-363.
- WEDLER, E., & LARSON, R. 1986. Athecate hydroids from Puerto Rico and the Virgin Islands. *Studies on Neotropical Fauna and Environment* 21: 69-101.
- WEILL, R. 1934a. Contribution à l'étude des Cnidaires et de leurs nématocystes. I. Recherches sur les nématocystes. Morphologie - Physiologie - Développement. *Travaux de la Station zoologique de Wimereux* 10: 1-347.
- WEILL, R. 1934b. Contribution à l'étude des Cnidaires et de leurs nématocystes. II. Valeur taxonomique du cnidôme. *Travaux de la Station zoologique de Wimereux* 11: 349-701.
- WEISMANN, A. 1883. Die Entstehung der Sexualzellen bei den Hydromedusen. Zugleich ein Beitrag zur Kenntnis des Baues und der Lebenserscheinungen dieser Gruppe. *Gustav Fischer, Jena*, pp. i-xiii, 1-295.
- WRIGHT, T. S. 1859. Observations on British zoophytes. *Edinburgh new Philosophical Journal* 10: 105-114, pls 8-9.
- YAMADA, M. 1954. Species of the genus *Eudendrium* from Japan. *Publications from the Akkeshi marine biological station* 2: 1-19.



Funnel web spiders from Sardinia: Taxonomical notes on some *Tegenaria* and *Malthonica* spp. (Araneae: Agelenidae)

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Funnel web spiders from Sardinia: Taxonomical notes on some *Tegenaria* and *Malthonica* spp. (Araneae: Agelenidae). - Based on specimens collected by hand during several field trips to Sardinia and on specimens examined in several collections, the female of *Tegenaria henroti* Dresco and the male of *Malthonica sardoa* Brignoli are described for the first time. *Malthonica eleonora* (Brignoli) is redescribed. It can be distinguished from *T. henroti*, which we regard as its sister species without yet proposing a new combination, by the number of teeth on the upper margin of the cheliceral groove and by the spine formulae of all leg tibiae. Additionally, the rim of the atrium, the form of the spermathecae, as well as the shape of the tegular apophysis and the ridge on the male bulb are important characters for separating these species. The female described under *T. henroti* by Wunderlich actually belongs to *M. dalmatica* (Kulczynski). The latter species would be new to Sardinia but has been recorded before on this island under the name *T. drescoi* Brignoli, which we consider as a new junior synonym of *M. dalmatica*. In addition, *Malthonica sicana* Brignoli is recorded for the first time from Sardinia, and the species is redescribed here. Males of the three species, *M. sardoa*, *M. sicana* and *M. arganoi* (Brignoli), can be distinguished by the shape of their retrolateral tibia apophysis, the shape of the terminal end of the conductor and the shape of the median apophysis.

Keywords: New male - new female - new synonym - taxonomy - species description.

INTRODUCTION

Malthonica Simon and *Tegenaria* Latreille represent two species-rich genera of agelenid spiders. They are predominantly Palearctic in distribution. Currently 41 valid species and one subspecies are listed in *Malthonica* and 101 species in *Tegenaria* (Platnick, 2008). These two genera are notorious for causing taxonomic problems: Lack of diagnoses, doubtful generic assignment of species, information available only for one sex in many species, unknown internal phylogenetic relationships between the species.

Teegenaria was erected by Latreille (1804) to include the species listed by Walckenaer (1802) under "Tapiformes": *T. domestica* (Clerck), *T. civilis* (Walckenaer) (= *T. domestica*), *T. agrestis* (Walckenaer) and *T. murina* (Walckenaer) (= *T. parietina* (Fourcroy)). The characters originally defining *Teegenaria* are the arrangement and size of the eyes, the almost square labium, the shape of the gnathocoxa, the leg formula, the elongated posterior spinnerets and the typical funnel web. Many species were added subsequently until Simon (1898) described *Maltonica* for a single species on the basis of procurved eye rows with small anterior median eyes, a narrow clypeus, a big tooth followed by several smaller teeth on the posterior margin of the cheliceral groove and segmented posterior spinnerets with the apical segment shorter than the basal (Simon, 1898; see also: Barrientos & Cardoso, 2007). *Maltonica* remained a genus with few species until Brignoli (1971, 1976a, b, 1978, 1980, 1984) added several species mostly on the basis of general similarity and small size, and hereby created taxonomic chaos. Guseinov *et al.* (2005) used the embolus length to separate *Teegenaria* from *Maltonica*. Apart from describing some new species from Azerbaijan they transferred several other species from *Teegenaria* to *Maltonica*. Jäger (2006) convincingly showed that this character, at least in Sparassidae, is unsuitable for phylogenetic evaluation. Furthermore Guseinov *et al.* (2005) omitted many described species from their list. In short, they added to the already existing confusion. Barrientos & Cardoso (2007) addressed this problem when describing a new species from Portugal. They redefined *Maltonica* for the Iberian species based on the original description of Simon (1898) and on a systematic evaluation by Lehtinen (1967). The current situation, presented in the catalogue of Platnick (2008), is extremely unsatisfactory as several pairs of apparently closely related species are assigned to different genera (e.g. *Maltonica eleonora* and the supposed sister species *Teegenaria henroti*). Another problem in dealing with species of the *Teegenaria-Maltonica*-complex is the fact that many species are known from one sex only (59 species = 41 %).

The purpose of the present paper is to improve the taxonomic knowledge of some species from Sardinia by providing descriptions of the previously unknown sex, one new synonymy and a new record. A phylogenetic analysis of the two genera is in progress (Bolzern in prep.) and is not the subject of the present paper. In order to avoid additional synonyms or new combinations, no generic rearrangements are made at this stage and the combinations used in the catalogue of Platnick (2008) are adopted here throughout.

MATERIAL AND METHODS

Material was examined from the Muséum d'histoire naturelle, Genève (MHNG), Muséum national d'Histoire naturelle, Paris (MNHN), Museo Civico di Storia Naturale, Verona (MSNV, holding P.M. Brignoli's collection), Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt am Main (SFM, holding the collection of J. Wunderlich (JW)). Additional hand collected material comes from M. A. Arnedo and colleagues (Universitat de Barcelona, Spain), as well as S. Ramseyer and A. Bolzern, and is deposited at the Naturhistorisches Museum Basel (NMB), the MHNG and MSNV.

Drawings were made using a Leica MZ12 stereomicroscope (with up to 110 x magnification) with a drawing tube. Most measurements were taken from digital pictures made with a Leica DFC320 camera and calculated with the programme ImageJ 1.38x (free software available on the internet at <http://rsb.info.nih.gov/ij/>). A few specimens were measured with an ocular scale bar. Measurements are taken from the dorsal side of the palps and legs. Eye-rows are straight, pro- or recurved according to the definition given in Jocqué & Dippenaar-Schoeman (2006) and Ubick *et al.* (2005). In frontal view, the eye-row is called “procurved” when the median eyes are situated more dorsally than the lateral eyes (Fig. 2). The number and arrangement of spines on femur, tibia and tarsus are presented in a spine formula. For each leg segment this formula gives the number in the following order: Dorsal - prolateral - retrolateral - ventral. A “p” indicates that at this position a pair of spines is present. E.g., the formula 2-2-2-1p+1+1p+1 stands for 2 dorsal, 2 prolateral, 2 retrolateral and 1 pair (2 spines at the same level close together) plus 1 plus 1 pair plus 1 ventral spine/spines (from proximal to distal; see Fig. 3). For clearing the vulva, the dissected epigynum has been placed into clove oil for several minutes. The descriptions of the palpal bulbs refer to the ventral view. The spines on the male palp (drawn in Fig. 13) are mostly not illustrated, as they are of no taxonomical significance.

The following abbreviations are used in the morphological sections (see also Figs 1-3): AER = anterior eye row; ALE = anterior lateral eyes; AME = anterior median eyes; AME-AME = distance between AME, expressed in eye diameters; AS = anterior spinnerets; AT = atrium of epigynum; BL/CL = ratio of bulb length / cymbium length; C = conductor; CD = copulatory duct; CHA = anterior (upper) margin of cheliceral groove; CHP = posterior (lower) margin of cheliceral groove; CLY1 = clypeus height measured below the AME; CLY2 = clypeus height measured below the ALE; CO = copulatory opening; DV = small diverticulum on the CD; E = length of apex of embolus; EP = epigynum; ET = epigynal teeth; FD = fertilisation duct; GNA = width/length ratio of gnathocoxa; MA = median apophysis; MS = median spinnerets; PA = patellar apophysis; PER = posterior eye row; PLA = posterior lateral eyes; PME = posterior median eyes; PME-AME = distance between PME and AME, expressed in eye diameters; PME-PME = distance between PME, expressed in eye diameters; PS = posterior spinnerets; R = distal ridge on tegulum of bulb; RTA = retrolateral tibia apophyses (used here for all structures in a retrolateral position on the male palp, therefore consisting of one, two or three branches); ST = spermathecae; TEA = tegular apophysis; TTN = tarsal trichobothria number (dorsally). Some measurements and characters, clypeus height and spine formula are illustrated in Figs 1-3.

TAXONOMY

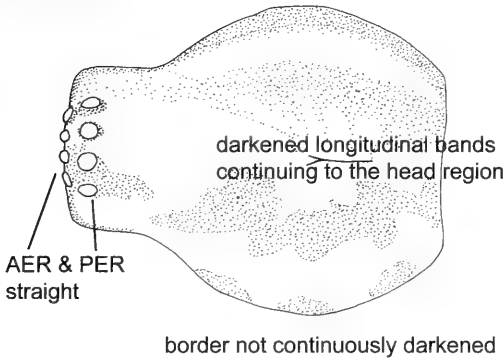
Malthonica dalmatica (Kulczynski, 1906)

Tegenaria dalmatica Kulczynski, 1906: 162-164.

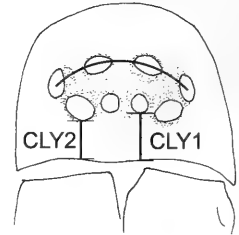
Tegenaria zinzulusensis Dresco, 1959: 506-509; synonymised by Levy (1996: 103) after Brignoli (1976b: 568-569).

Tegenaria drescoi Brignoli, 1971: 110-112; **syn. n.**

Malthonica dalmatica (Kulczynski). – Guseinov *et al.* (2005: 164).

1 dorsal view border continuously darkened**2 frontal view**

PER distinctly procurved
AER slightly procurved

**3 ventral view of leg tibia**

spine formula: x - x - x - $\underbrace{1p (= \text{pair}) + 1 + 1p + 1}_{\text{ventral}}$
dorsal - prolateral - retrolateral - ventral

FIGS 1-3

Schematic drawings of carapace and tibia of a *Tegenaria* specimen. (1) Dorsal view of carapace with two different colour patterns. (2) Frontal view of carapace. (3) Ventral view of a leg tibia with a possible spine pattern. AER = anterior eye row, CLY1 = clypeus height measured under the anterior median eyes, CLY2 = clypeus height measured under the anterior lateral eyes, PER = posterior eye row. "p" (= paired) in the spine formula indicates that a pair of spines is situated at the same level on the tibia.

TYPE MATERIAL EXAMINED: ♀ holotype of *T. drescoi* (MSNV, vas. 543); Castelsardo, Sassari, Sardinia, IT; leg. A. Vigna, 28.4.1967; det. P. M. Brignoli.

OTHER MATERIAL EXAMINED: 1 ♀ (JW, described under *T. henroti* by Wunderlich (1994)); "NSG oberhalb Baunei", Ogliastra, Sardinia, IT; leg. J. Wunderlich, "in V"; det. J. Wunderlich. - 1 ♂, 3 ♀ (SFM, nr. 8939/4-135, published under *T. pagana* (C.L. Koch) by Kraus (1955)); "Höhle bei Sassari", Sardinia, IT; leg. K. Schnellbäcker, 6.4.1952; det. A. Bolzern. - 14 ♀ (MNHN, nr. 1953, loc. 481, specimens were in a tube with specimens of *T. pagana*, det. E. Simon); "Gallia merid., Cors.", FR; leg. E. Simon; det. A. Bolzern. - 1 ♀ (MNHN, nr. 1965, loc. 460, specimen was in the type series of *T. armigera* Simon); Corsica, FR; leg. E. Simon; det. A. Bolzern.

DESCRIPTION: Descriptions and figures of both sexes were published by Kulczynski (1906), Dresco (1959), Brignoli (1971), Levy (1996), Dimitrov (1999), Ledoux (2004) and Kovblyuk & Nadolny (2007).

DISTRIBUTION: Reported from Montenegro (Kulczynski, 1906), Italy including Sardinia and Sicily (Dresco, 1959; Brignoli, 1971; Wunderlich, 1994, female under *T. henroti*), Greece and Cyprus (Brignoli, 1976b; 1979b), Bulgaria (Deltshv, 1995),

Israel (Levy, 1996), mainland France (department Var) (Ledoux, 2004) and Corsica (Simon, 1873, one female under *T. armigera*). *M. dalmatica* was not previously known from Corsica. The species occurs also in Croatia, Lebanon and Tunisia (unpublished data, JW, NMB and MSNV under *T. zinzulusensis*).

COMMENTS: The examination of numerous specimens of *M. dalmatica*, including material from France, Greece, Lebanon and Italy, showed a high degree of variation in the arrangement of the ST and in the dimensions of the CT. The holotype of *T. drescoi* lies within this range of variation and the name is therefore synonymised with *T. dalmatica*. Brignoli (1971) mentioned that the holotype of *T. drescoi* is morphologically close to *T. zinzulusensis*, and the latter similar to *T. dalmatica* (see Brignoli, 1976b), which led Levy (1996) to synonymise *T. zinzulusensis* with *T. dalmatica*.

***Tegenaria henroti* Dresco, 1956**

Figs 4-7

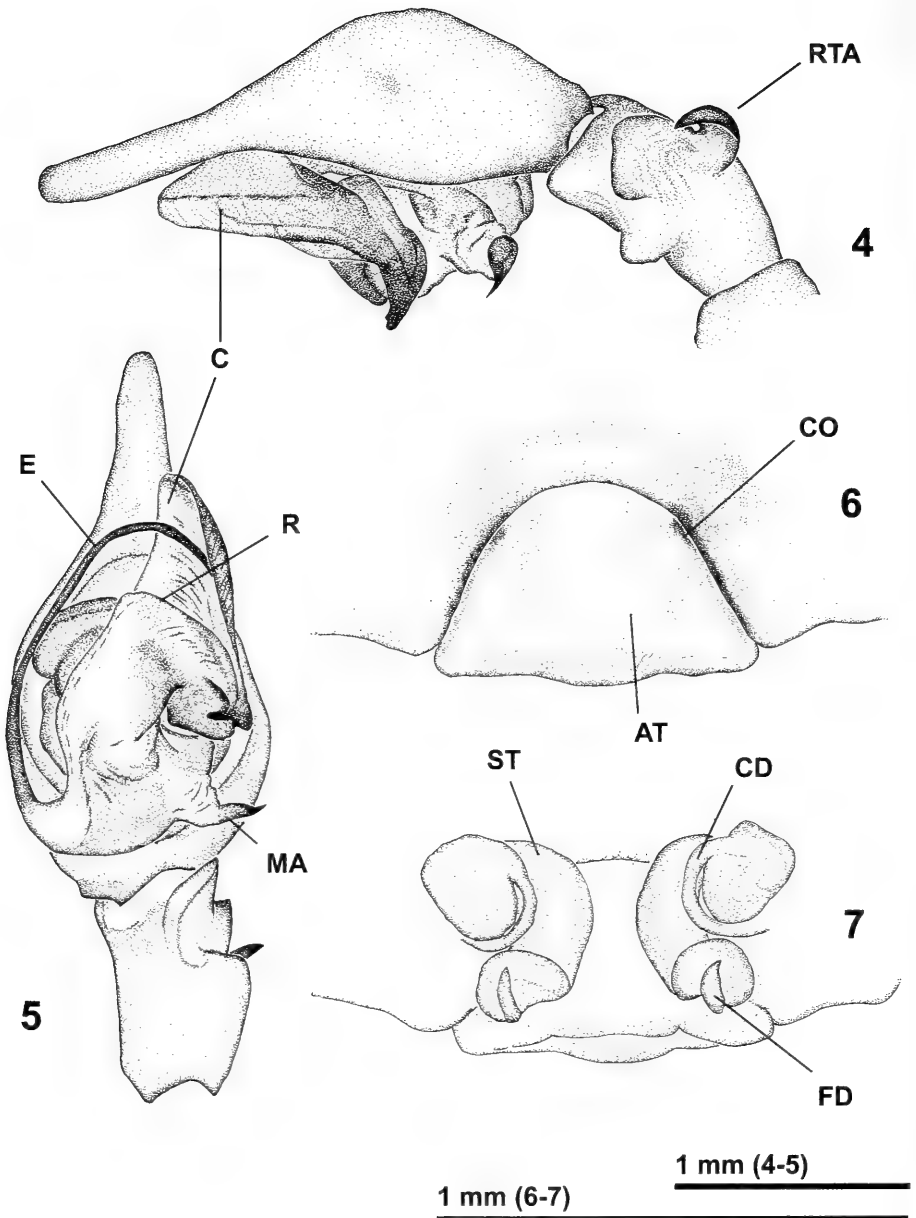
Tegenaria henroti Dresco, 1956: 115-118.

MATERIAL EXAMINED: 1 ♂ (MHNG); "Grotta di Gonone", Cala Gonone, Nuoro, Sardinia, IT; leg. P. Strinati & V. Aellen, 20.3.1971; det. P. M. Brignoli (Brignoli, 1974). – 1 ♂ (JW); "NSG oberhalb Baunei", Ogliastra, Sardinia, IT; leg. J. Wunderlich, "in V"; det. J. Wunderlich. – 1 ♂, 1 ♀ (SFM, nr. 11299-135, under *T. domestica*); "Höhle Buo Marino", Sardinia, IT; leg. Patrizi; det. A. Bolzern. – 1 ♂ (Figs 4-5), 1 ♀ (Figs 6-7) (NMB, 2791a, b); Cave NNE of Cala Gonone, Cala Gonone, Nuoro, Sardinia, IT (40°17'39"N / 9°38'50"E, altitude: 3 m); leg. A. Bolzern & S. Ramseyer, 5.7.2006 (then juv.); det. A. Bolzern. – 1 ♀, 16 juv. (NMB, 2791c); Cave at Cala Luna, Cala Gonone, Nuoro, Sardinia, IT (40°13'37"N / 9°37'37"E, altitude: 5 m); leg. A. Bolzern & S. Ramseyer, 6.7.2006; det. A. Bolzern. – 4 ♀, 4 juv. (MHNG); small cave above "Grotte Sa Oche", Valle di Lanaito, Oliena, Nuoro, Sardinia, IT (40°15'23"N / 9°29'10"E); leg. A. Bolzern & S. Ramseyer, 7.7.2006; det. A. Bolzern.

The female from the "Cave NNE of Cala Gonone, 5.7.2006" was juvenile when collected and was reared in the laboratory at the NMB. It reached maturity in November 2006. The depository of the type material is unknown.

DESCRIPTION OF FEMALE (the ♀ described by Wunderlich (1994) under *T. henroti* actually belongs to *T. dalmatica*): Prosoma: Carapace: Plumose hairs present. 5.05 mm long, 4.01 mm wide in male (n=1); 3.66-5.91 mm long, 2.71-4.4 mm wide in females (n=4). Ratio fovea/carapace length: 0.115-0.167. Border not continuously darkened, two longitudinal darkened bands present, strongest pigmentation close to head region, sometimes very weakly pronounced. Head region without a pattern. AER slightly recurved and PER straight in dorsal view; AER slightly procurved and PER strongly procurved in frontal view. AME smallest, other eyes equal in size. PME-PME longer than half their diameter; PME-AME equal to the diameter of PME; AME-AME equal to half their diameter or slightly longer. CLY1 2-3 x the diameter of AME; CLY2 equal to or slightly higher than the diameter of ALE. Chelicerae: 2.22 mm long, 0.88 mm wide in male; 1.64-2.75 mm long, 0.78-1.15 mm wide in female. CHA: 4 teeth; CHP: 4-6 teeth. Chelicerae uniformly brownish. Labium: As long as wide or slightly wider than long. GNA: 0.497-0.576. Sternum: 2.56 mm long, 2.28 mm wide in male; 1.77-2.82 mm long, 1.71-2.58 mm wide in female. Pale median band and 3 pale dots on each side, not clearly delimited and sometimes fused together.

Legs: Plumose hairs present. Annulated, especially on femora and tibiae. Trochanter straight. TTN on legs I-IV: 8-9. For leg measurements see Tables 1 and 2



FIGS 4-7

Tegenaria henroti Dresco. (4) Left male palp, retrolateral view. (5) Same, ventral view. (6) Epigynum, ventral view. (7) Vulva, dorsal view. AT = atrium, C = conductor, CD = copulatory duct, CO = copulatory opening, E = embolus, FD = fertilisation duct, MA = median apophysis, R = ridge on tegulum, RTA = retrolateral tibia apophysis, ST = spermatheca.

TABLE 1: Leg measurements (in mm) and leg formula of males of *Tegenaria henroti*, *Malthonica eleonorae*, *M. sardoa* and *M. sicana* (*specimen from Sicily).

		<i>T. henroti</i> (n=1)	<i>M. eleonorae</i> (n=1)	<i>M. sardoa</i> (n=3)	<i>M. sicana</i> (n=1*)
Palp	Femur	2.05	1.82	0.94-1.15	1.25
	Patella	0.85	0.62	0.35-0.42	0.46
	Tibia	1.07	0.80	0.38-0.46	0.66
	Cymbium	2.40	1.83	0.93-1.12	0.91
	(Bulb)	(1.67)	(1.29)	(0.67-0.92)	(0.42)
	Total	6.37	5.07	2.60-3.15	3.28
Leg I	Femur	8.00	5.94	2.43-3.22	3.92
	Patella	2.05	1.59	0.76-0.94	1.00
	Tibia	8.65	5.76	2.16-3.24	3.85
	Metatarsus	9.22	6.3	2.10-3.16	3.55
	Tarsus	3.65	3.07	1.33-1.58	1.82
	Total	31.57	22.66	8.78-12.14	14.14
Leg II	Femur	8.11	5.90	2.12-2.53	2.92
	Patella	1.90	1.60	0.74-0.77	0.91
	Tibia	7.48	5.35	1.64-2.09	2.57
	Metatarsus	8.45	6.00	1.80-2.25	2.70
	Tarsus	3.00	2.77	1.16-1.36	1.53
	Total	28.94	21.62	7.46-9.00	10.63
Leg III	Femur	7.18	5.25	1.99-2.35	2.62
	Patella	1.84	1.39	0.71-0.82	0.94
	Tibia	6.42	4.42	1.51-1.83	2.00
	Metatarsus	8.33	5.95	1.86-2.38	2.66
	Tarsus	2.88	2.33	1.04-1.16	1.18
	Total	26.65	19.34	7.11-8.54	9.40
Leg IV	Femur	7.98	6.12	2.67-3.15	2.52
	Patella	1.91	1.49	0.76-0.89	0.86
	Tibia	6.95	5.75	2.44-2.86	2.16
	Metatarsus	10.19	7.35	2.75-3.38	2.70
	Tarsus	3.10	2.73	1.29-1.56	1.34
	Total	30.13	23.44	9.91-11.84	9.58
Formula		I > IV > II > III	IV > I > II > III	IV = I > II > III	I > II > IV > III

(one female from the "Grotte Sa Oche" was much bigger than the others and had only legs 1 and 2 left). For spine formulae see Table 3.

Opisthosoma: 6.71 mm long, 4.74 mm wide in male; 4.57-5.24 mm long, 3.34-3.52 mm wide in females. Plumose hairs present. Anterior part with pale median band and big pale dots on both sides, mottled; pale dots continuing to posterior part in chevrons, posterior part with dark ground colour. Spinnerets: PS longer than all others; distal segment as long as or longer than the basal one, basal segment slightly darkened or both segments pale. MS as long as AS. Colulus forming a more or less rectangular plate, wider than long.

Male palp (Figs 4-5): PA absent. RTA with lateral, dorsal and ventral branch; lateral branch lamella-like; dorsal branch strongly sclerotized, horn-like; ventral apophysis developed as a big not strongly sclerotized bulge. Cymbial modifications absent. BL/CL 0.7. Alveolus length 1.31 mm. Embolus filiform, becoming more

TABLE 2: Leg measurements (in mm) and leg formula of females of *Tegenaria henroti*, *Malthonica eleonorae*, *M. sardoa* and *M. sicana*. The values in parentheses for *M. sicana* are measurements of an extremely large paratype specimen (in MHNG) from Sicily. Leg I of one of the two *M. sardoa* females examined is missing.

		<i>T. henroti</i> (n=4)	<i>M. eleonorae</i> (n=3)	<i>M. sardoa</i> (n=2)	<i>M. sicana</i> (n=4 + paratype)
Palp	Femur	1.79-2.86	1.54-1.90	0.81-0.96	0.90-0.99 (1.3)
	Patella	0.70-1.02	0.66-0.79	0.35-0.38	0.40-0.44 (0.5)
	Tibia	1.16-1.82	1.00-1.22	0.51-0.59	0.58-0.63 (1.0)
	Tarsus	1.85-2.97	1.65-2.04	0.83-0.92	0.75-0.92 (1.2)
	Total	5.50-8.67	4.85-5.95	2.50-2.85	2.63-2.98 (4.0)
Leg I	Femur	5.52-9.02	4.79-5.96	1.85	2.03-2.22 (3.3)
	Patella	1.51-2.35	1.54-1.67	0.70	0.72-0.84 (1.0)
	Tibia	5.06-8.80	4.60-6.31	1.61	1.90-2.01 (3.3)
	Metatarsus	5.33-9.41	4.89-6.44	1.48	1.77-1.89 (3.0)
	Tarsus	2.49-3.80	2.39-2.95	1.09	1.13-1.24
	Total	19.91-33.38	18.21-23.33	6.73	7.55-8.2
Leg II	Femur	4.86-8.46	4.44-5.73	1.63-1.90	1.76-1.89 (2.8)
	Patella	1.45-2.32	1.40-1.74	0.64-0.75	0.71-0.79 (1.1)
	Tibia	4.31-7.76	3.96-5.22	1.26-1.47	1.33-1.41 (2.5)
	Metatarsus	5.04-8.92	4.48-5.98	1.25-1.56	1.47-1.53 (2.4)
	Tarsus	2.05-3.45	2.15-2.58	0.87-0.92	0.92-1.00 (1.5)
	Total	17.71-30.91	16.43-21.25	5.65-6.6	6.19-6.62 (10.3)
Leg III	Femur	4.50-4.95	5.04-5.36	1.52-1.75	1.65-1.79 (2.7)
	Patella	1.30-1.44	1.41-1.53	0.61-0.71	0.67-0.74 (0.9)
	Tibia	3.79-4.28	4.35-4.42	1.16-1.39	1.22-1.29 (2.2)
	Metatarsus	4.68-5.25	5.13-5.52	1.37-1.74	1.56-1.68 (2.7)
	Tarsus	1.78-1.91	2.20-2.33	0.80-0.93	0.86-0.91 (1.4)
	Total	16.05-17.83	18.13-19.16	5.46-6.52	5.96-6.41 (9.9)
Leg IV	Femur	5.07-5.55	6.03-6.38	2.06-2.46	2.28-2.45 (3.5)
	Patella	1.37-1.49	1.59-1.71	0.66-0.73	0.68-0.83 (1.0)
	Tibia	4.81-5.18	5.54-5.81	1.78-2.23	2.06-2.21 (3.3)
	Metatarsus	6.25-6.89	7.40-7.47	1.99-2.53	2.35-2.51 (3.8)
	Tarsus	2.14-2.39	2.59-2.59	0.91-1.28	1.08-1.21 (1.8)
	Total	19.64-21.5	23.15-23.96	7.40-9.23	8.45-9.21 (13.4)
Formula		IV = I > II > III	IV > I > II > III	IV > I > II > III	IV > I > II > III

slender distally, shorter than 2 x cymbium width, curved through approximately 180°. Embolus base on left palp at 7-8 o'clock position. Median apophysis thorn-like, spirally elongated at 5 o'clock position. Connection between median apophysis and tegulum membranous. Conductor as long as alveolus, triangular, parallel to cymbium and folded along its entire length. Terminal end of conductor developed as a strongly sclerotized peak. Sharp boundary present between conductor and tegulum, clearly visible as a ridge (R). Subtegulum mostly hidden by tegulum and conductor.

Epigynum and vulva (Figs 6-7): EP: 0.52-0.63 mm long, 1.06-1.48 mm wide. Atrium: 0.33-0.40 mm long, 0.49-0.65 mm wide, forming a membranous triangular or trapezoid plate (Fig. 6). Anterior and lateral margin of atrium developed as a strongly sclerotized border. EP not salient. Spermathecae and/or copulatory ducts barely visible through plate. Epigynal teeth absent. Copulatory openings only visible as more

TABLE 3: Spination of legs of *Tegenaria henroti*, *Malthonica eleonorae*, *M. sardoa* and *M. sicana*. The formula gives the number of spines in the following order: Dorsal - prolateral - retro-lateral - ventral. A "p" indicates that at this position a pair of spines is present (1p = 2 spines at almost the same height). All observed spine formulas are presented; only obviously abnormal (teratological?) spinations were ignored. More than one spine formula per taxon and leg segment indicates variation.

	Species	Femur	Tibia	Tarsus	
Leg I	<i>T. henroti</i>	2-3-1-0	0-1-0-0	0	
		2-3-2-0	2-1-0-0		
	<i>M. eleonorae</i>	2-3-3-0	2-0-0-1p	0	
		2-3-2-0	2-0-0-1+1p		
		2-4-3-0	2-1-0-1+1p		
	<i>M. sardoa</i>	2-1-0-0	0-0-0-2	0	
		2-2-0-0	0-0-0-1+1p		
		2-2-1-0			
	<i>M. sicana</i>	2-1-0-0	0-0-0-2	0	
		2-2-0-0	0-0-0-1+1p		
			0-1-0-2p		
	Leg II	<i>T. henroti</i>	2-3-2-0	0-1-0-0	0
			2-1-0-0		
<i>M. eleonorae</i>		2-2-2-0	2-1-0-2	0	
		2-3-2-0	2-2-0-2		
		2-4-2-0			
<i>M. sardoa</i>		2-1-0-0	0-1-0-2	0	
		2-1-1-0	0-1-0-1+1p		
<i>M. sicana</i>		2-1-0-0	0-1-0-2	0	
		2-1-1-0	2-1-0-1+1p		
Leg III		<i>T. henroti</i>	2-2-2-0	2-1-1-0	0-0-1-0
		<i>M. eleonorae</i>	2-2-2-0	2-2-2-1	0-0-1-0
				2-2-2-1p+1	
	<i>M. sardoa</i>	1-1-1-0	2-1-1-2	0	
		2-1-1-0	2-2-1-2		
	<i>M. sicana</i>	1-1-1-0	2-2-1-2	0	
		2-1-1-0	2-2-1-3		
			2-2-2-2		
			2-2-2-1+1p		
			2-2-2-2p		
	Leg IV	<i>T. henroti</i>	1-1-1-0	1-1-1-0	0-0-1-0
			2-1-1-0	2-1-1-1	
2-2-1-0					
<i>M. eleonorae</i>		2-1-1-0	2-2-2-1	0-0-1-0	
			2-2-2-2		
<i>M. sardoa</i>		1-1-1-0	2-2-2-3	0	
			2-2-2-1+1p		
			2-2-2-2+1p		
<i>M. sicana</i>		1-1-1-0	2-2-2-3	0-0-1-0	
			2-2-2-1p+1+1p+1	0-1-1-0	

strongly sclerotized regions on both sides of atrium. Vulva (Fig. 7): Copulatory ducts narrow; spermathecae developed as tube-like ducts, in the anterior and posterior part slightly convoluted. Fertilisation ducts short.

DISTRIBUTION: This species is only known from the east coast of Sardinia. It has been found in caves of Nuoro Province (Brignoli, 1974; Dresco, 1956; present study) and in the province of Ogliastra (Wunderlich, 1994).

COMMENTS: The references to *T. henroti* by Brignoli (1971), including the drawings of epigynum and vulva (p. 72, Figs 11-12), refer to *M. eleonora* (see Brignoli, 1974, 1977). One female described here (Figs 6-7) was collected in the same cave as a male of *T. henroti*. The conspecificity of male and female is supported by the teeth on the margins of the cheliceral groove, the leg spine formula and many other somatic characters. Additionally, the female from this location, though similar to females of *M. eleonora*, clearly differs from them morphologically.

Wunderlich (1994) described a female, which he had found together with a male of *T. henroti*. This specimen was wrongly associated with *T. henroti*; our re-examination showed that it belongs to *Malthonica dalmatica* (see above).

Malthonica eleonora (Brignoli, 1974)

Figs 8-11

Tegenaria eleonora Brignoli, 1974: 390-391.

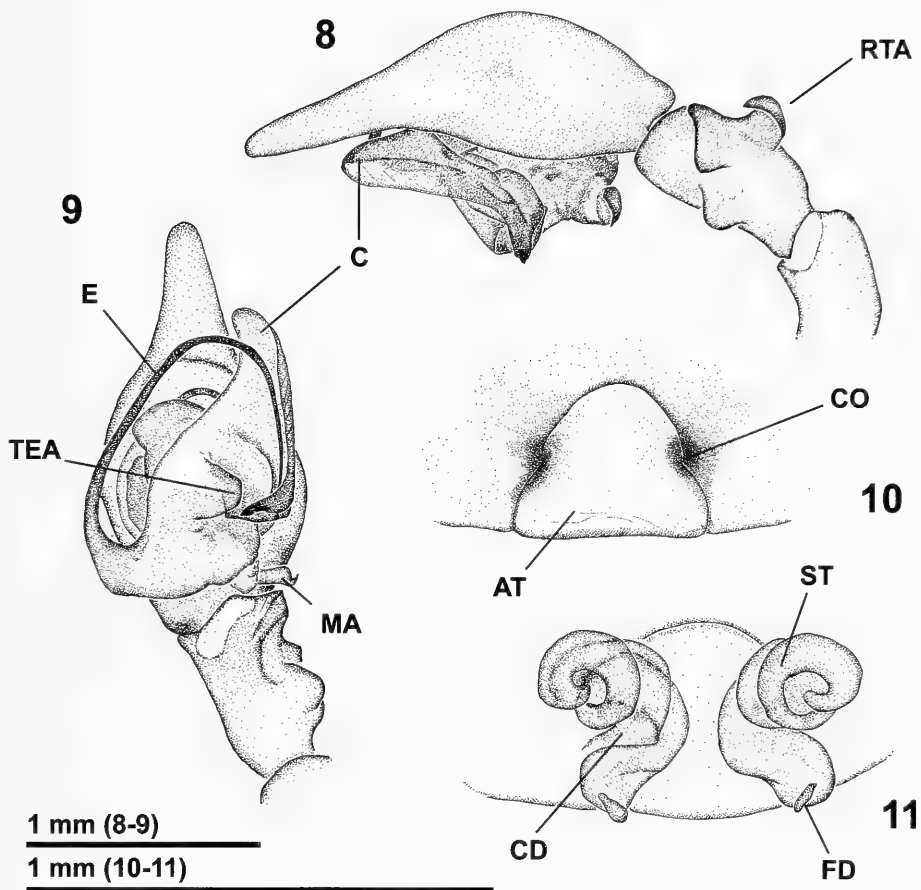
Malthonica eleonora (Brignoli). – Guseinov *et al.* (2005: 164).

TYPE MATERIAL EXAMINED: ♂ holotype, 1 ♀ paratype (MSNV, vas. 543); “Grotta di S. Giovanni”, Domusnovas, Cagliari, Sardinia, IT; leg. R. Pilia & G. Usai, 6.10.1968; det. P. M. Brignoli. – 1 ♀ paratype (MSNV, vas. 543); from the type locality; leg. G. Pirodda, M. Latte & M. Pinna, 8.9.1968; det. P. M. Brignoli. – 1 ♀ paratype (MSNV, vas. 543); from the type locality; leg. A. Vigna, 28.2.1971; det. P. M. Brignoli. – 1 ♀ paratype (MHNG); from the type locality; leg. A. Vigna.

OTHER MATERIAL EXAMINED: 2 ♀ (MSNV, vas. 52); “Grotta I di Monte Figù”, Iglesias, Cagliari, Sardinia, IT; leg. S. Puddu, 20.5.1973; det. P. M. Brignoli. – 1 ♂ (Figs 8-9, MSNV, vas. 52); “Grotta di S. Giovanni, M. Acque”, Domusnovas, Cagliari, Sardinia, IT; leg. S. Puddu, 5.3.1972; det. P. M. Brignoli. – 1 ♀ (MSNV, vas. 52); “Grotta sa Fossa e Su Fenutrainu”, Domusnovas, Cagliari, Sardinia, IT; leg. A. Lecis & M. Pote, 2.4.1972; det. P. M. Brignoli. – 2 ♀ (MSNV, vas. 52); “Grotta is Angurtidorgius, su Pranu (Perdasdegogu)”, Sardinia, IT; leg. S. Puddu, 4.11.1973; det. P. M. Brignoli. – 2 ♀ (Figs 10-11, NMB, 2792a); “Grotta di S. Giovanni”, Domusnovas, Sardinia, IT (39°19'56"N / 8°37'4"E); leg. A. Bolzern & S. Ramseyer, 9.7.2006; det. A. Bolzern.

DESCRIPTION: Prosoma: Carapace: Plumose hairs present. 3.8 mm long, 3.1 mm wide in male (n=1); 3.57-4.43 mm long, 2.7-3.39 mm wide in female (n=3). Ratio fovea/carapace length: 0.113-0.169. Colouration as in *T. henroti*. Eyes and clypeus same pattern as in *T. henroti*. Chelicerae: 1.6 mm long, 0.7 mm wide in male; 1.66-2.15 mm long, 0.75-0.93 mm wide in females. CHA: 3 teeth; CHP: 4-5 teeth. Colouration as in *T. henroti*. Labium as long as wide or slightly wider than long. GNA: 0.525-0.622. Sternum: 1.9 mm long, 1.8 mm wide in male; 1.78-2.15 mm long, 1.65-2.1 mm wide in female. Colouration as in *T. henroti*.

Legs: Plumose hairs present. Annulated, especially on femora and tibiae (in the paratypes probably bleached due to alcohol preservation). Trochanter straight. TTN on legs I-III: 8; leg IV: 8-9. For leg measurements see Tables 1 and 2. For spine formulas see Table 3.



FIGS 8-11

Malthonica eleonora (Brignoli). (8) Left male palp, retrolateral view. (9) Same, ventral view. (10) Epigynum, ventral view. (11) Vulva, dorsal view. AT = atrium, C = conductor, CD = copulatory duct, CO = copulatory opening, E = embolus, FD = fertilisation duct, MA = median apophysis, RTA = retrolateral tibia apophysis, ST = spermatheca; TEA = tegular apophysis.

Opisthosoma: 4.28-5.67 mm long, 3.05-4.32 mm wide in females. Plumose hairs present. Colouration as in *T. henroti*, but less pigmented. Spinnerets: PS longer than all others; pale distal segment as long as the darkened basal one. MS as long as or slightly shorter than AS. Colulus forming a more or less rectangular plate, wider than long.

Male palp (Figs 8-9): PA absent. RTA with lateral, dorsal and ventral branch; lateral branch lamella-like; dorsal branch strongly sclerotized, horn-like; ventral apophysis forming a big, weakly sclerotized bulge. Cymbial modifications absent. BL/CL: 0.7. Alveolus length 1.01 mm. Embolus filiform, becoming more slender distally, shorter than 2 x cymbium width, curved through approximately 200°. Embolus base on

left palp at 7 o'clock position. Median apophysis thorn-like and spirally elongated at 5 o'clock position. Connection between median apophysis and tegulum membranous. Conductor as long as alveolus, triangular, parallel to cymbium and folded along its entire length. Terminal end of conductor developed as a strongly sclerotized peak. Boundary between conductor and tegulum not continuous. Tegular apophysis flat, much more protruding than in *T. henroti*. Subtegulum mostly hidden by tegulum and conductor.

Epigynum and vulva (Figs 10-11): EP: 0.47-0.48 mm long, 0.82-0.97 mm wide. Atrium: 0.30-0.36 mm long, 0.38-0.46 mm wide, in the shape of a membranous triangular or trapezoidal plate (Fig. 10). Anterior and lateral margin of atrium forming strongly sclerotized rim, not continuous. EP not salient. Spermathecae and/or copulatory duct hardly visible through plate. Epigynal teeth absent. Copulatory openings only visible as more strongly sclerotized regions on both sides of atrium. Vulva (Fig. 11): Copulatory ducts broad. Spermathecae developed as tube-like ducts, anteriorly weakly spiral, posteriorly only moderately convoluted. Fertilisation ducts short. Due to a slightly different position of the two ducts, the vulva may not be perfectly symmetrical (Fig. 11).

DISTRIBUTION: This species is only known from the south of Sardinia. It has been found in two caves in Carbonia-Iglesias Province (Brignoli, 1974; Brignoli, 1977) and in one cave in the south of Ogliastra Province. Up to now, no overlap in the ranges of *M. eleonora* and *T. henroti* were observed.

COMMENTS: The suggestion of Wunderlich (1994) that *M. eleonora* may be a junior synonym of *T. femoralis* Simon is not supported here. The two species clearly differ in morphology and distribution (Brignoli, 1979a; Kraus, 1955).

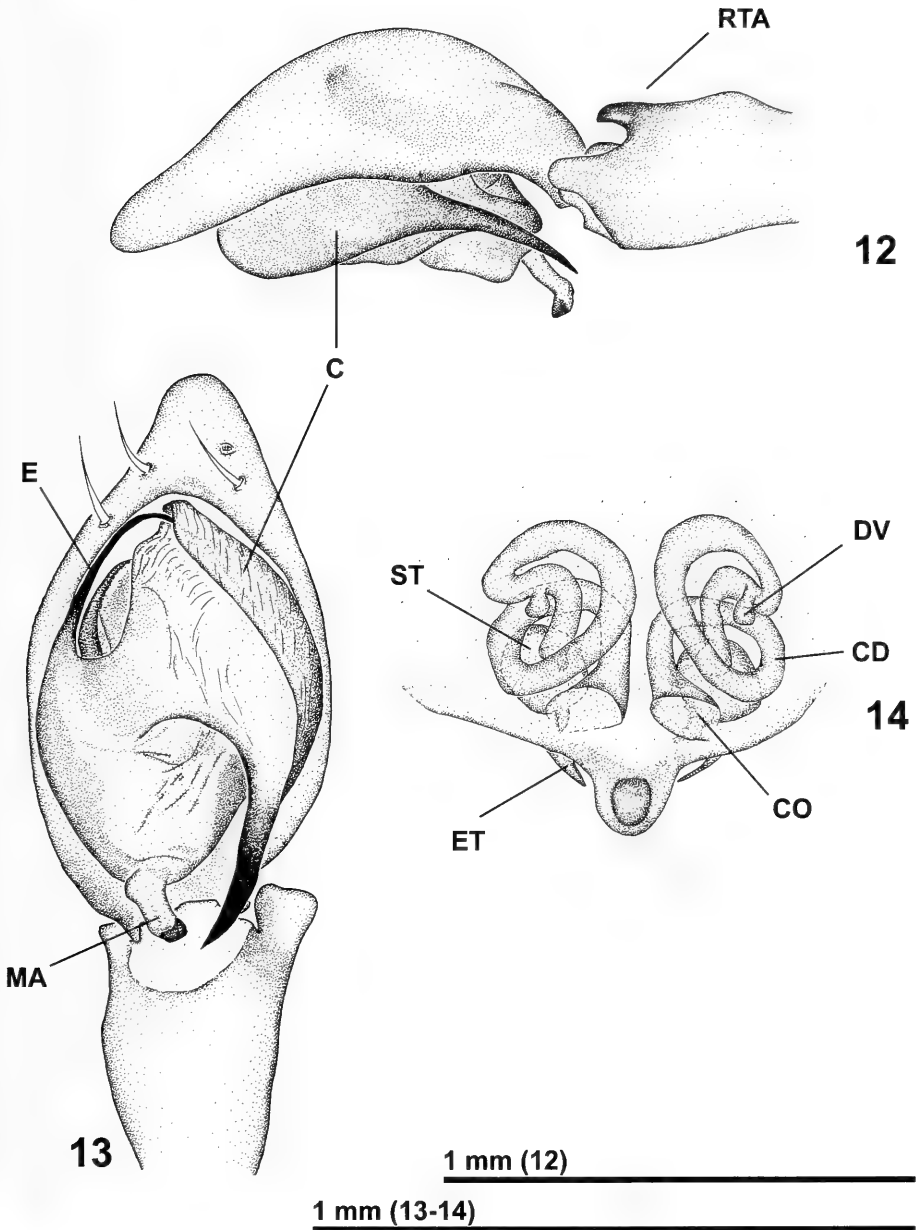
M. eleonora can be separated from *T. henroti* by the number of teeth on the upper margin of cheliceral groove and by the spine formula of all leg tibiae (Table 2). *M. eleonora* always has ventral spines on tibiae I-III, which are absent in *T. henroti*. Females can be distinguished by the almost straight borders on both sides of the genital atrium in *T. henroti* (Fig. 6), whereas in *M. eleonora* these borders are clearly invaginated (Fig. 10). Additionally, the vulva of *M. eleonora* has broader copulatory ducts, anteriorly convoluted and posteriorly less twisted spermathecae (Fig. 11, cf. Fig. 7). The distinction of males is possible on the basis of two characters of the tegulum: The sclerotized lobe median of the conductor (TEA) is more protruding in *M. eleonora* than in *T. henroti*, and the ridge (R), which is running from the terminal end of the conductor across the conductor, reaches in *M. eleonora* only half (Figs 8-9), in *T. henroti* the whole width of the conductor (Figs 4-5). Additionally, the male palp is relatively smaller in *M. eleonora* than in *T. henroti*.

Malthonica sardoa Brignoli, 1977

Figs 12-14

Malthonica sardoa Brignoli, 1977: 38-39.

TYPE MATERIAL EXAMINED: ♀ holotype (MSNV, vas. 62); "dintonri di Asuni", Cagliari, Sardinia, IT; leg. A. Vigna, 20.2.1971; det. P. M. Brignoli. - 1 ♀ paratype (MSNV, vas. 62); "Grotta di S. Giovanni, M. Acque", Domusnovas, Cagliari, Sardinia, IT; leg. S. Puddu, 5.3.1972; det. P. M. Brignoli. - 1 ♀ paratype (MSNV, vas. 62); "Cant. Gaddau, Limbara", Sassari, Sardinia, IT; leg. P. M. Brignoli, 30.3.1971; det. P. M. Brignoli. - 1 ♀ paratype (MNHN, nr.



FIGS 12-14

Malthonica sardoa Brignoli. (12) Left male palp, retrolateral view. (13) Same, ventral view. (14) Female epigynum and vulva, ventral view. C = conductor, CD = copulatory duct, CO = copulatory opening, DV = small diverticulum on the CD, E = embolus, ET = epigynal teeth, MA = median apophysis, RTA = retrolateral tibia apophysis, ST = spermatheca.

1942); "M. d'Iscudo, vers. N", Sardinia, IT (altitude: 1300 m); collector unknown; det. P. M. Brignoli. – 1 ♀ paratype (MHNG); "dint. Asumi", Oristano, Sardinia, IT; leg. A. Vigna, 22.2.1971; det. P. M. Brignoli. – 1 ♀ paratype (MNHN); "Monte d'Iscudo", Nuoro, Sardinia, IT (altitude: 1300 m); leg. G. Franzini, 6.9.1975; det. P. M. Brignoli.

OTHER MATERIAL EXAMINED: 1 ♂, 2 ♀ (Fig. 14; NMB, 2793a); "Morgongiori, Mt. Arci", Oristano, Sardinia, IT (39°46'17"N / 8°44'48"E, altitude: 761 m); leg. M. A. Arnedo & M. Mejia, 15.10.2005, "open *Quercus* forest with mosses"; det. A. Bolzern. – 2 ♂ (Figs 12-13; MSNV); "Desulo, Mt. Gennargentu", Nuoro, Sardinia, IT (altitude: 1146 m); leg. M. A. Arnedo, M. Mejia & G. Giribet, 17.10.2005, "*Quercus pub.*, humid"; det. A. Bolzern.

DESCRIPTION OF MALE: Prosoma: Carapace: Plumose hairs present. 1.97-2.36 mm long, 1.61-1.89 mm wide in males (n=3); 1.86-2.19 mm long, 1.33-1.56 mm wide in females (n=2). Ratio fovea/carapace length: 0.10-0.13. Border continuously darkened, two very broad dark longitudinal bands continuing to head region, broader than the pale median band. Both eye rows straight or AER slightly recurved in dorsal view; both rows strongly procurved in frontal view. AME smallest, all other eyes equal in size. PME-PME about their diameter; PME-AME less than the diameter of PME; AME-AME less than or about half their diameter. CLY1 about 1?–2 x the diameter of AME; CLY2 less than or as high as the diameter of ALE. Chelicerae: 0.84-0.95 mm long, 0.36-0.42 mm wide in males; 0.84-0.96 mm long, 0.37-0.46 mm wide in females. CHA: 3 teeth; CHP: 8-9 (4-6 bigger and 3-5 smaller) teeth. Chelicerae uniformly brownish. Labium as long as wide or slightly wider than long. GNA: 0.517-0.538. Sternum: 1.15-1.27 mm long, 1.03-1.18 mm wide in males; 1.01-1.23 mm long, 0.96-1.02 mm wide in females. Only a pale median band present.

Legs: Plumose hairs present. No colour pattern. Trochanter straight. TTN on legs I-IV: 5-6. For leg measurements see Tables 1 and 2. For spine formulas see Table 3.

Opisthosoma: 2.1-2.63 mm long, 1.31-1.59 mm wide in males; 2.12-2.61 mm long, 1.53-1.7 mm in females. Plumose hairs present. Ground colour dark gray-green, anterior half with two symmetric bright longitudinal bands continuing to the back in chevrons and then in spots. Spinnerets: PS longer than all others; distal segment longer than basal one, both darkened or distal segment pale. Colulus forming a more or less rectangular plate, wider than long.

Male palp (Figs 12-13): PA absent. RTA with dorsolateral and lateral branches; dorsolateral branch simple, more or less pointed; lateral branch bigger than the dorsolateral branch, spoon-like. BL/CL: 0.678-0.819. Alveolus length 0.67-0.92 mm. Embolus filiform, becoming more slender distally, less than 1½ x cymbium widths, curved through 150°. Embolus origin on the left palp at approximately 9 o'clock position. Median apophysis a narrow oblong band, terminally spoon-like. Conductor longer than alveolus, continuously connected to the tegulum, parallel to margin of cymbium and folded along its entire length. Terminal end of conductor spine-like, big, strongly sclerotized. Subtegulum mostly hidden by tegulum and conductor.

Epigynum and vulva (Fig. 14): EP: 0.53-0.59 mm long, 0.53-0.62 mm wide. No delimited atrium visible. EP not salient. Posterior margin of the EP plate forming a rounded swelling with a circular depression reaching over the epigastric furrow. Spermathecae and/or copulatory ducts well visible through the plate. Epigynal teeth present, narrow but long. Copulatory openings well visible as holes, located in posterior half of EP. Vulva (Fig. 14): Copulatory ducts very long and winded; Small

diverticula on the copulatory ducts present. One pair of globular spermathecae present, separated by their diameter. Fertilisation ducts short.

DISTRIBUTION: This species can be found all over Sardinia (Brignoli, 1977). The known sites are all in higher altitudes (> ca. 700 m).

COMMENTS: Up to now, the male of *M. sardoa* was unknown. The finding of a male together with two females of *M. sardoa* strongly suggests that they are conspecific. The *M. sardoa* male is similar to those of *Malthonica arganoi* and *Malthonica sicana* from which it differs in the proportions of the cymbium and the bulb, and in the following three characters: 1) *M. arganoi* has an RTA with ventral, lateral and dorsal branches, whereas *M. sardoa* and *M. sicana* have an RTA with only dorsolateral and lateral branches; 2) the conductor of *M. sardoa* has a much longer, strongly sclerotized and more pointed tip compared to the corresponding structures in the other species; 3) the median apophysis of *M. sardoa* (Figs 12-13) is more slender and elongated, whereas in the other two species it is much shorter and broader (Figs 15-16, 19-20). The females can easily be distinguished from those of the other species by the morphology of the epigynum and vulva (Fig. 14; Brignoli, 1976a: 43, fig. 22). Furthermore, *M. arganoi* is, until now, only recorded from the Italian mainland regions Lazio, Umbria (Brignoli, 1971; Brignoli, 1977) and Calabria (not yet published).

Malthonica sicana Brignoli, 1976

Figs 15-18

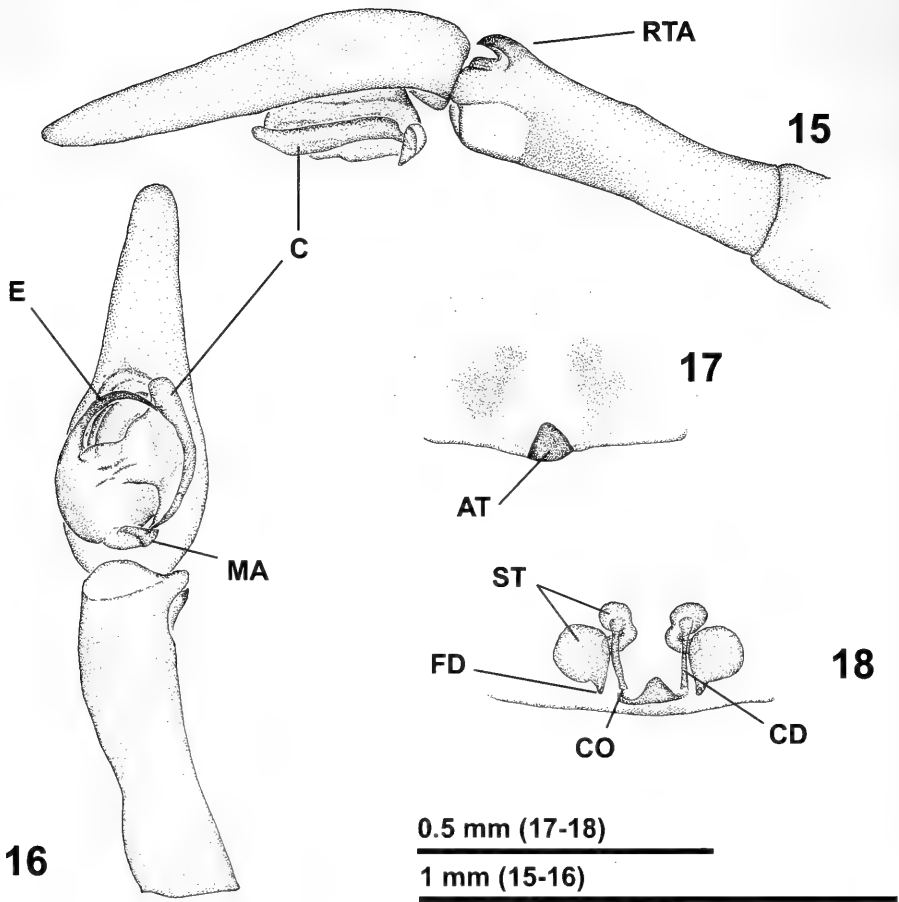
Malthonica sicana Brignoli, 1976: 30-33.

TYPE MATERIAL EXAMINED: ♀ holotype (MSNV, vas. 62); “Piana degli Albanesi”, Palermo, Sicily, IT; leg. Aliquo, 20.11.1972; det. P. M. Brignoli. – 1 ♀ paratype (MSNV, vas. 62); “M. Maganoce”, Palermo, Sicily, IT; leg. A. Vigna, 2.5.1974; det. P. M. Brignoli. – 1 ♀ paratype (MSNV, vas. 62); “Bosco Ficuzza”, Palermo, Sicily, IT; leg. A. Vigna, 4.5.1974; det. P. M. Brignoli. – 1 ♂, many ♀ paratypes (MSNV, vas. 62); “Carini, Grotta del Puntale”, Palermo, Sicily, IT; leg. A. Vigna, 30.4.1974; det. P. M. Brignoli. – 1 ♀ paratype (MHNG); “Grotta del Puntale”, Carini, Sicily, IT; leg. M. Bologna, 01.01.1976; det. P. M. Brignoli.

OTHER MATERIAL EXAMINED: 2 ♀ (Figs 17-18; NMB, 2794a); “Mt. Ferru, road Cuglieri - S. Leonardo”, Oristano, Sardinia, IT (40°9'47"N / 8°37'11"E); leg. M. A. Arnedo & M. Mejia, 14.10.2005, “open *Quercus* forest, rich leaf litter”; det. A. Bolzern. – 2 ♀, 1 juv. (MHNG); “Mt. Ferru, 7 Fuentes, road Cuglieri - S. Leonardo”, Oristano, Sardinia, IT (40°10'46"N / 8°35'8"E); leg. M. A. Arnedo & M. Mejia, 14.10.2005 “*Quercus* forest, open, not wet”; det. A. Bolzern. – 1 ♂ (Figs 15-16; NMB, 2794b); “Mte. Pelegrino, at the W-slope”, Palermo, Sicily, IT (38°11'14"N / 13°20'40"E, altitude: 114 m); leg. A. Bolzern & R. Mühlethaler, 23.5.2007 (juv.) “under stones”; det. A. Bolzern.

The male collected by Bolzern & Mühlethaler was reared to maturity in the laboratory at the NMB. It reached adulthood in October 2007.

DESCRIPTION: Prosoma: Carapace: Plumose hairs present. 2.60 mm long, 2.01 mm wide in male (n=1); 2.15-2.75 mm long, 1.56-2.00 mm wide in females (n=4). Ratio fovea/carapace length: 0.08-0.29. Border continuously darkened, two relatively indistinct, broad longitudinal dark bands and a pale median band (one paratype pale brownish only, without bands, head region slightly darker; probably due to preservation in alcohol). Both eye rows straight in dorsal view; both rows strongly procurved in frontal view. AME smallest, other eyes equal in size. PME-PME 1-1½ x their diameter; PME-AME ½-1 x the diameter of the PME; AME-AME ½-1 x their diameter. CLY1 2-3 x the diameter of AME; CLY2 smaller than or as high as the diameter of

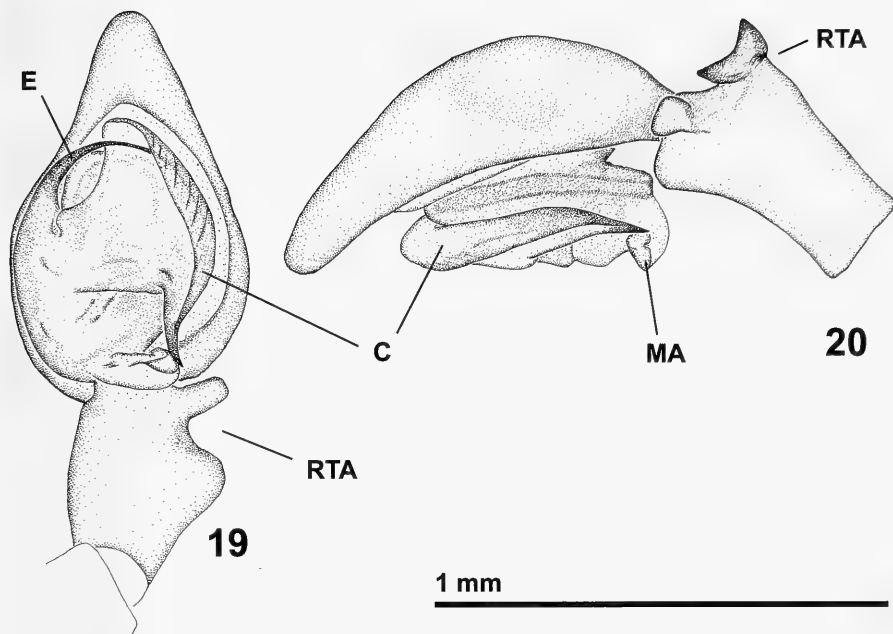


FIGS 15-18

Maltonica sicana Brignoli. (15) Left male palp, retrolateral view. (16) Same, ventral view. (17) Epigynum, ventral view. (18) Vulva, dorsal view. AT = atrium, C = conductor, CD = copulatory duct, CO = copulatory opening, E = embolus, FD = fertilisation duct, MA = median apophysis, RTA = retrolateral tibial apophysis, ST = spermatheca.

ALE. Chelicerae: 1.20 mm long, 0.55 mm wide in male; 0.92-1.46 mm long, 0.45-0.70 mm wide in female. CHA: 3 teeth; CHP: (5 in male) 8-9 teeth (5 bigger and 3-4 smaller ones). Chelicerae partly pigmented, sometimes very weakly so. Labium slightly wider than long. GNA: 0.480-0.589. Sternum: 1.40 mm long, 1.28 mm wide in male; 1.21-1.52 mm long, 1.02-1.30 mm wide in females. Only a pale median band present.

Legs and palps: Plumose hairs present. Female palps with dark pigmentation on patella and tibia, weakly pronounced. Legs annulated, in some paratypes no pattern visible (maybe due to alcohol preservation). Trochanter straight. TTN on legs I-II and IV: 5-6, leg III: 5. For leg measurements see Tables 1 and 2. For spine formulas see Table 3.



FIGS 19-20

Malthonica arganoi (Brignoli). Specimen from "Parco Naz. del Pollino", Cosenza, Calabria, IT; leg. & det. A. Bolzern, 2007. (19) Left male palp, ventral view. (20) Same, retrolateral view. C = conductor, E = embolus, MA = median apophysis, RTA = retrolateral tibia apophysis.

Opisthosoma: 2.79 mm long, 1.65 wide in male; 2.11-3.01 mm long, 1.61-2.03 mm wide in females. Plumose hairs present. Ground colour dark gray-green, with two symmetric bright longitudinal bands anteriorly, discontinuous, ending posteriorly in 3-4 chevrons. Spinnerets: PS longer than all others, distal segment longer than basal one, both darkened. Colulus forming a more or less rectangular plate, wider than long.

Male palp (Figs 15-16): PA absent. RTA with dorsolateral and lateral branches; dorsolateral branch simple, more or less pointed; lateral branch as long as the dorsolateral branch, lobe-like. BL/CL: 0.464. Alveolus length 0.41 mm. Embolus filiform, becoming more slender distally, less than $1\frac{1}{2}$ x cymbium widths, curved through 150° . Embolus origin on the left palp at 9 o'clock position. Median apophysis short, pocket-like, terminally spoon-like. Conductor as long as or longer than alveolus, continuously connected to the tegulum, parallel to the cymbium margin and folded along its entire length. Terminal end of conductor pointed, sclerotized. Subtegulum mostly hidden by tegulum and conductor.

Epigynum and vulva (Figs 17-18): EP: 0.17-0.23 mm long, 0.29-0.40 mm wide. Atrium visible as a cavity in posterior view, covered by a triangular, strongly sclerotized plate (Fig. 17). Anterior and posterior margins of EP not pronounced. EP strongly salient. Spermathecae and/or copulatory ducts weakly visible through EP plate. Epigynal teeth absent. Copulatory openings indistinct. Vulva (Fig. 18): Copulatory ducts short and straight. Two pairs of globular spermathecae present. Fertilisation ducts short.

DISTRIBUTION: Previously known only from Sicily (Brignoli, 1976a), *M. sicana* is reported here for the first time from Sardinia. The findings of four females at two localities (collected by hand) suggest that the species is fairly common there.

COMMENTS: The species is easily recognisable by the very distinct vulva shape (Fig. 18). Brignoli (1976a) mentioned a very high variability in body size, which is confirmed in the present study (Table 2). Except for a very large female paratype, the specimens from Sicily lie approximately in the same size range as those from Sardinia. This also holds true for the leg spine formulas (Table 3).

DISCUSSION

In his checklist of Italian spiders Pesarini (1994; see also www.faunaitalia.it) listed eleven *Malthonica* and *Tegenaria* species from Sardinia: *Malthonica campestris* (C.L. Koch) (under *T. campestris*), *M. eleonorae* (under *T. eleonorae*), *M. pagana* (C.L. Koch) (under *T. pagana*), *M. sardoa*, *M. soriculata* (Simon) (under *T. soriculata*), *Tegenaria agrestis* (Walckenaer), *T. armigera* Simon, *T. domestica* (Clerck), *T. drescoi*, *T. henroti* and *T. parietina* (Fourcroy). Here we replace the record of *T. drescoi* with that of *M. dalmatica* and add *M. sicana* to the spider list of Sardinia.

M. eleonorae, *M. sardoa* and *T. henroti* are endemic to Sardinia. *M. soriculata* and *M. armigera* are known from Sardinia and Corsica, *M. sicana* from Sardinia and Sicily only. This high rate of endemism may be explained by the fact that these spiders are troglophilous.

We know only about two publications recording *M. soriculata* from Sardinia (Kraus, 1955: 379, under *T. soriculata*, and Garneri, 1902: 72). Already Brignoli (1971: 67) expressed some doubts about the validity of these two records: "sarebbe interessante un controllo di questo materiale, date le somiglianze esistenti tra questa specie e *T. henroti* ...". The material treated by Kraus (1955) was checked in the spider collection of the Senckenberg Museum and proved to be a misidentification of *T. parietina*. The material treated by Garneri (1902) could not be traced. Since we could not confirm any specimens of *M. soriculata* from Sardinia, we question its presence there and assume that it only occurs on Corsica.

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REFERENCES

- BARRIENTOS, J. A. & CARDOSO, P. 2007. The genus *Malthonica* Simon, 1898 in the Iberian Peninsula (Araneae: Agelenidae). *Zootaxa* 1460: 59-68.
- BRIGNOLI, P. M. 1971. Contributo alla conoscenza degli Agelenidae italiani (Araneae). *Fragmenta Entomologica* 8: 57-142.
- BRIGNOLI, P. M. 1974. Ragni d'Italia XXI. Settimo contributo alla conoscenza dei ragni cavernicoli di Sardinia e descrizione di una nuova specie di Corsica (Araneae). *Revue suisse de Zoologie* 81: 387-395.
- BRIGNOLI, P. M. 1976a. Ragni d'Italia XXVI. Su di una nuova *Malthonica* di Sicilia parassitata da un dittero acroceride. *Bollettino dell'Associazione Romana di Entomologia* 30: 30-35.
- BRIGNOLI, P. M. 1976b. Ragni di Grecia IX. Specie nuove o interessanti delle famiglie Leptonetidae, Dysderidae, Pholcidae ed Agelenidae (Araneae). *Revue suisse de Zoologie* 83: 539-578.
- BRIGNOLI, P. M. 1977. Ragni d'Italia XXVII. Nuovi dati su Agelenidae, Argyronetidae, Hahniidae, Oxyopidae e Pisauridae, cavernicoli ed epigei (Araneae). *Quadern periodico del Museo di Speleologia "V. Rivera"* 2(4): 3-81.
- BRIGNOLI, P. M. 1978. Quelques notes sur les Agelenidae, Hahniidae, Oxyopidae et Pisauridae de France et d'Espagne (Araneae). *Revue suisse de Zoologie* 85: 265-294.
- BRIGNOLI, P. M. 1979a. Ragni d'Italia XXXI. Specie cavernicole nuove o interessanti (Araneae). *Quaderni periodico del Museo di Speleologia "V. Rivera"* 5(10): 1-48.
- BRIGNOLI, P. M. 1979b. Ragni di Grecia XI. Specie nuove o interessanti, cavernicole ed epigee. *Revue suisse de Zoologie* 86: 181-202.
- BRIGNOLI, P. M. 1980. Some new or interesting Eastern Mediterranean *Dysderidae* and *Agelenidae* (Araneae). *Annales Zoologici* 35: 75-82.
- BRIGNOLI, P. M. 1984. Ragni di Grecia XII. Nuovi dati su varie famiglie (Araneae). *Revue suisse de Zoologie* 91: 281-321.
- DELTSHEV, C. 1995. A review of the family Agelenidae (Araneae) in Bulgaria. Taxonomic, faunistic and zoogeographical analysis. *European Journal of Entomology* 82: 581-588.
- DIMITROV, D. 1999. The spider fauna of the Strandzha Mountain (south-east Bulgaria) I. Faunistic data and taxonomic remarks (Arachnida: Araneae). *Acta Zoologica Bulgarica* 51(2/3): 15-26.
- DRESCO, E. 1956. *Tegenaria henroti*, espèce nouvelle des grottes de Sardaigne (Araneae, Agelenidae). *Fragmenta Entomologica* 2: 115-119.
- DRESCO, E. 1959. *Tegenaria zinzulusensis*, araignée nouvelle d'Italie du sud (Araneae, Agelenidae). *Bulletin du Muséum national d'histoire naturelle, Paris* 2(31): 506-509.
- GARNERI, A. 1902. Contribuzione alla fauna Sarda - Aracnidi. *Bollettino della Società Zoologica Italiana*, 3: 57-103.
- GUSEINOV, E. F., MARUSIK, Y. M. & KOPONEN, S. 2005. Spiders (Arachnida: Aranei) of Azerbaijan. 5. Faunistic review of the funnel-web spiders (Agelenidae) with description of new genus and species. *Arthropoda Selecta* 14(2): 153-177.
- JÄGER, P. 2006. Lengthening of embolus and copulatory duct: a review of an evolutionary trend in the spider family Sparassidae (Araneae). *Acta Zoologica Bulgarica, Supplementum I (Proceedings of the 22nd European Colloquium of Arachnology, Blagoevgrad 2005)*: 49-62.
- JOCQUÉ, R. & DIPPENAAR-SCHOEMAN, A. S. 2006. Spider families of the world. *Royal Museum for Central Africa*, 336 pp.
- KOVBLIYUK, M. M. & NADOLNY, A. A. 2007. *Malthonica dalmatica* (Kulczynski, 1906) from the Crimea, a spider new to the former Soviet Union (Aranei: Agelenidae). *Arthropoda Selecta* 16(1): 19-22.
- KRAUS, O. 1955. Spinnen von Korsika, Sardinien und Elba (Arach., Araneae). *Senckenbergiana Biologica* 36(5/6): 371-394.

- KULCZYNSKI, V. 1906. Araneorum species novae tres in Dalmatia a Dr^ce Cornelio Chyzer lectae. *Annales historico-naturales Musei nationalis Hungarici* 4: 157-164.
- LATREILLE, P. A. 1804. Tableau méthodique des insectes. *Nouveau Dictionnaire d'Histoire Naturelle, Paris* 24: 129-295.
- LEDoux, J.-C. 2004. De araneis Galliae. I.9, *Tegenaria dalmatica* Kulczynski. *Revue Arachnologique* 15: 23-24.
- LEHTINEN, P. T. 1967. Classification of the cribellate spiders and some allied families, with notes on the evolution of the suborder Araneomorpha. *Annales Zoologici Fennici* 4: 199-468.
- LEVY, G. 1996. The agelenid funnel-weaver family and the spider genus *Cedicus* in Israel (Araneae, Agelenidae and Cybaeidae). *Zoologica Scripta* 25(2): 85-122.
- PESARINI, C. 1994. Arachnida Araneae. In: MINELLI, A., RUFFO, S. & LA POSTA, S. (eds). Checklist delle specie della fauna italiana. *Edizioni Calderini, Bologna* 23: 1-42.
- PLATNICK, N. I. 2008. The world spider catalog, version 9.0. *American Museum of Natural History*, online at <http://research.amnh.org/entomology/spiders/catalog/index.html>
- SIMON, E. 1873. Aranéides nouveaux ou peu connus du midi de l'Europe. (2me mémoire). *Mémoires de la Société Royale des Sciences de Liège*, II. Série 5(8): 187-351 (181-177).
- SIMON, E. 1898. Descriptions d'arachnides nouveaux des familles des Agelenidae, Pisauridae, Lycosidae et Oxyopidae. *Annales de la Société entomologique de Belgique* 42: 1-34.
- UBICK, D., PAQUIN, P., CUSHING, P. E. & ROTH, V. 2005. Spiders of North America: an identification manual. *American Arachnological Society*, 377 pp.
- WALCKENAER, C. A. 1802. Fauna parisienne, insects ou histoire abrégée des insects des environs de Paris, classés d'après le système de Fabricius. 2. *Dentu, Paris*, XXII + 438 pp.
- WUNDERLICH, J. 1994. Zur Kenntnis der Endemiten, zur Evolution und zur Biogeographie der Spinnen Korsikas und Sardiniens, mit Neubeschreibungen (Arachnida: Araneae). *Beiträge zur Araneologie* 4: 353-383.

A new species of the genus *Geocharis* Ehlers, 1883 and some faunistic data on endogean carabids from Portugal (Coleoptera: Carabidae)

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A new species of the genus *Geocharis* Ehlers, 1883 and some faunistic data on endogean carabids from Portugal (Coleoptera: Carabidae). -

One endogean carabid of the genus *Geocharis* Ehlers, 1883 (Carabidae: Trechinae, Anillini) from Portugal, *Geocharis rodriguesi* n. sp., is described. The work provides diagnostic characters of this species, and in particular, the structure of male genitalia. Affinities with closely related species, as well as ecological and distribution comments are also included. A key for the identification of the males of the *Geocharis* species found North of the Tejo River in Portugal is given. Faunistic notes on endogean carabids from Portugal are also presented.

Keywords: Coleoptera - Carabidae - Trechinae - *Geocharis rodriguesi* n. sp. - Portugal - Iberian Peninsula.

INTRODUCTION

The ground beetle subtribe Anillina have representatives occurring in many parts of the world, such as North and South America, Africa (especially Madagascar), Asia Minor, southern Asia, New Zealand and Mediterranean Europe (Sokolov *et al.*, 2004). The genera *Geocharis* Ehlers, 1883 and *Thyphlocharis* Dieck, 1869 belong to this subtribe and are very speciose in the Iberian Peninsula, with 28 and 46 species recognized, respectively, for this Peninsula, (Serrano, 2003; Serrano & Aguiar, 2004a, 2006a, 2006b, 2006c, in press; Serrano *et al.*, 2005; Zaballos, 2005; Andújar *et al.*, 2008). The knowledge of the systematics and distribution of *Geocharis* species from Portugal has notably increased over the last several years. There are seventeen species of *Geocharis* occurring in this Iberian country and, within this assemblage, four species are found exclusively at north of the Tejo River and thirteen at south of the same river (see Serrano & Aguiar, 2004a, 2006a).

The species of *Geocharis* are endogean, living in soil and can be found frequently on the bottom surface of the deeply imbedded stones. All species are eyeless (anophtalmous) and apterous. Many species seem very restricted in distribution (precinctive) (e.g., *G. portalegrensis* Serrano & Aguiar, 2000, *G. boieiroi* Serrano & Aguiar, 2001), while others occur across large geographic areas (e.g., *G. femoralis* Coiffait, 1968, *G. coiffaiti* Serrano & Aguiar, 2006), both reflecting local and regional patterns of endemism.

This work provides descriptions of one new species of the genus *Geocharis* from Portugal. Moreover we provide a key to males of all known species of *Geocharis* found north of the Tejo River in Portugal and additional geographic distribution data for *G. olisipensis* Schatzmayr, 1937, *G. quartau* Serrano & Aguiar, 2004, *Typhlocharis paulinoi* Serrano & Aguiar, 2006 and *Hypotyphlus lusitanicus* Serrano & Aguiar, 2004.

MATERIAL AND METHODS

Field work conducted in several regions of Portugal namely in some areas near the Cascais region and in the Serra de Montejunto (Province of Estremadura), Pedrógão Grande (Province of Beira Baixa), Serra de Monchique (Province of Algarve) and Ourique and Santa Margarida da Serra (Province of Baixo Alentejo), resulted in the collection of specimens of endogean beetle species of the subtribe Anillina. After a careful study, we concluded that the sampled specimens from Cascais region represent one new species to the science of the genus *Geocharis*. Part of the remaining specimens belong to two *Geocharis* species (*G. olisipensis* and *G. quartau*), one to the genus *Typhlocharis* (*T. paulinoi*) and one to the genus *Hypotyphlus* (*H. lusitanicus*). The specimens were direct hand collected under sunken stones in fragments of Mediterranean forest habitats dominated by holm-oaks, rock-roses shrubs and lentisk bushes (*Quercus coccifera* Linnaeus, *Cistus ladanifer* Linnaeus and *Pistacia lentiscus* Linnaeus, respectively). While in the Cascais region and in the Serra de Montejunto habitats the substrate is calcareous, in Pedrógão Grande, Serra de Monchique, Ourique and Santa Margarida da Serra the substrate is schistic. At all regions the clayey soils are of brown reddish colour. Additional specimens were obtained from samples of soil taken from the above-mentioned localities using Berlese apparatus.

The morphological study of adult specimens was done using a scanning electron microscope JEOL JSM-5200 LV. Measurements and drawings were done with a Wild M5 stereoscopic microscope equipped with a dissecting microscope ocular micrometer and a drawing tube. Cephalic chaetotaxy follows the terminology of Zaballo (2005).

The distribution of species in the descriptions is given in U.T.M. coordinates (1 km x 1 km). For practical reasons, the map used for the representation of distributions is of 10 km x 10 km squares (Fig. 11). Therefore some localities could be enclosed in the same 10 km x 10 km square.

RESULTS

Geocharis rodriguessi n. sp.

Figs 1-10

Type series. HOLOTYPE: Portugal, Alcabideche (Murches) (U.T.M. coordinates: 29SMC6288), 30.III.2006; PARATYPUS: same locality of Holotype, 30.III.2006, 1 ♂ 1 ♀; 7.IV.2006, 26 ♂♂, 9 ♀♀ (2 ♂♂, 2 ♀♀ gold coated), 23.XI.2007, 38 ♂♂, 32 ♀♀; Cascais (Malveira) (U.T.M. coordinates: 29SMC6188), 30.III.2006, 1 ♂. Holotype and 102 paratypes are deposited in the collection of the senior author, Department of Animal Biology (Faculdade de Ciências da Universidade de Lisboa). Six paratypes (3 ♂♂, 3 ♀♀) are deposited in the collection of the Muséum d'histoire naturelle Genève, Switzerland.

Diagnosis: Anophtalmous; body slightly depressed, brown with integument microreticulate. A sparse pubescence mainly on pronotum and elytra. Elytron without striae, only humeral region punctured, disk with one anterior seta and a posterior one. Male forelegs with the first tarsomere dilated. Males with a more or less developed median tooth on the internal margin of the metafemora, females without or with a very slight tooth. Mesotibiae with dense pubescence in both margins. Hind tibiae more or less right. Aedeagus as in Figs 9-10.

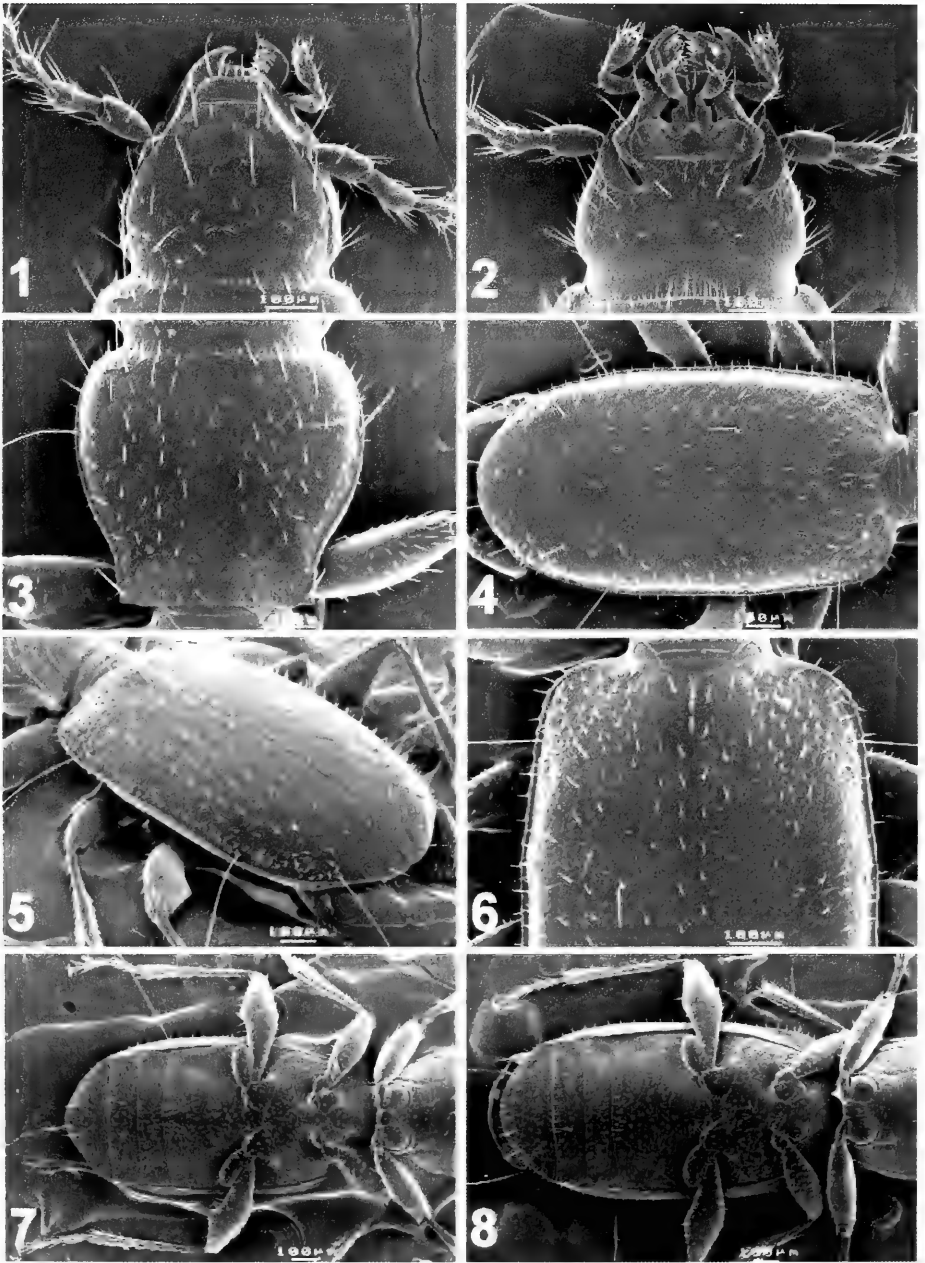
Description: Length of holotype: 2.0 mm. Length of paratypes: 1.9-2.3 mm (males and females). Head (Fig. 1) more or less as long as wide [length: 0.34-0.48 mm (males), 0.34-0.42 mm (females)]; width: 0.43-0.48 (males), 0.38-0.45 mm (females)], microsculpture distinct. Cephalic chaetotaxy (fixed setae of left side): F3+C1+F1+SA1+SP1+V1+O1+P1+G2. Antennae light brown, the 1st and 2nd articles longer than the others, the latter subpyriform, the 3rd and the 4th are the shortest ones and subpyriforms, the 5th to the 10th gradually longer and oval-shaped, the last one acuminate. Mouth-parts (Fig. 2) show the general pattern of the genus.

Pronotum cordiform (Fig. 3) with round anterior angles, about 1.2 times wider than long [length: 0.43-0.52 mm (males), 0.42-0.48 mm (females)]; width: 0.49-0.61 mm (males), 0.50-0.56 mm (females); disk slightly convex, depressed between the two basal pits, with a superficial central sulcus which do not reach the anterior margin; this margin and posterior margin slightly arcuate (Fig. 3); lateral margins with 3 or 4 denticles just before the posterior angles, which are right and dentate; Vestiture (pubescence): surface covered with scattered erect pubescence; one seta on the lateral margin in the broadest part of the pronotum, another one near the posterior angle; 2 additional setae inserted near the anterior angles.

Elytra (Fig. 4) 1.7-1.8 times longer than wide [length: 1.09-1.31 mm (males), 1.09-1.22 mm (females), width: 0.62-0.74 mm (males), 0.61-0.72 mm (females)], slightly convex, subparallel and oval posteriorly; the tegument microsculptured and just punctured in the shoulders (Fig. 6); disk without striae; lateral margin narrow, finely serrate from the humeral angles, which are rounded, to the 5th seta of the umbilicate series. Vestiture (pubescence): part of the pubescence of the disk is arranged in 5-6 irregular lines, these setae are erect and slightly directed anteriorly (Figs 4-5); umbilicate series follows the pattern of the genus. The longest setae of this series are the 2nd, the 6th and the 9th with the 3rd, 5th, 7th and 8th, more slightly inserted within the elytral margin; besides these setae there are 1 parascutellar basad, 2 discal (1 anterior and 1 posterior) and 1 apical seta (Figs 4-5).

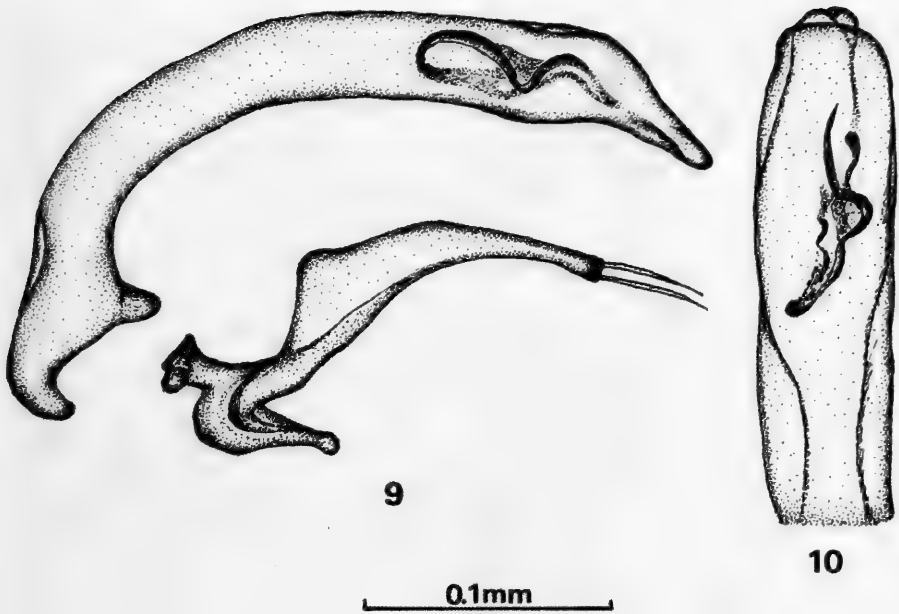
Male legs with the 1st protarsomere dilated; 1st tarsomere in all legs more pigmented (light brown) than the others; mesotibiae with a strong pubescence on both margins; hind femora (males) with a more or less strong median tooth on the internal margin (Fig. 7), females without or with a very slight tooth (Fig. 8).

Male genitalia (Figs 9-10) with median lobe strongly arcuate, slightly enlarged in the basal margin before the apex (lateral view), apex broadly sharp and slightly bent down, basal lobe with apophysis prominent; internal sac as in figures 9-10; left and right parameres with 2 apical setae, left paramere with dorso-basal edge slightly expanded (Fig. 9).



FIGS 1-8

Geocharis rodriguessi n. sp. (1) Head (dorsal view). (2) Head (ventral view). (3) Pronotum (dorsal view). (4) Elytra (dorsal view). (5) Left elytron (latero-dorsal view). (6) Anterior half of elytra (dorsal view). (7) Thorax and abdomen (male, ventral view). (8) Thorax and abdomen (female, ventral view).



FIGS 9-10

Aedeagus of *Geocharis rodriguesi* n.sp. (9) Median lobe and left paramere in lateral view. (10) Apex of median lobe in dorsal view.

The female genitalia general pattern as for the other species of the genus (e.g., Zaballos & Jeanne 1987; Zaballos 1998; Zaballos, 2005). Female genitalia (not shown) with gonocoxite IX sickle-shaped, a long ensiform seta in the middle region of the external margin, one ensiform seta in the middle dorsal region and a double nematiform seta in the internal margin near the beginning of the apical third. Gonosubcoxite IX without special features; laterotergite IX with a variable number of setae (more or less 20). Internal genitalia with a subspherical spermatheca, duct of spermathecal gland short, gland fusiform, middle region membranous, apical portion sclerotized.

Etymology: This new species is dedicated to Professor Pedro Rodrigues, who has greatly contributed to the taxonomic knowledge of the Heteroptera Tingidae, mainly of Afrotropical Region and Portugal, and become a remarkable academic reference to the senior author.

MORPHOLOGICAL AFFINITIES

Geocharis rodriguesi n. sp. is akin to most species of *Geocharis* by the possession on the elytral disk of two setae, one anterior and one posterior. Some other species of *Geocharis* present a different number and/or localization of these discal setae which are: *G. cordubensis* (Dieck, 1869) and *G. rotundata* Serrano & Aguiar, 2006 (three pairs of setae: one anterior, one median and a posterior one) and *G. olisipensis* Schatzmayr, *G. falcipenis* Zaballos & Jeanne, 1987 and *G. ruiztapiadori* Zaballos, 1996 (one or two pairs of setae: A posterior one only, or both a median and a posterior ones).

The new species presents a tooth on the internal margin of the hind femora of males such as many other of the genus (*Geocharis leoni* Zaballo, 1998, *G. cordubensis*, *G. femoralis* Coiffait, *G. grandolensis* Serrano & Aguiar, 2000, *G. portalegrensis* Serrano & Aguiar, *G. saldanhai* Serrano & Aguiar, 2000, *G. boieiroi* Serrano & Aguiar, *G. estremoensis* Serrano & Aguiar, 2003, *G. sacarraoi* Serrano & Aguiar, 2003, *G. fermini* Serrano & Aguiar, 2004, *G. quartai* Serrano & Aguiar, 2004, *Geocharis juncoi* Zaballo, 2005, *G. coiffaiti* Serrano & Aguiar, 2006 and *G. rotundata*).

Geocharis rodriguesi n. sp and *G. iborensis* Zaballo, 1990 present a general conformation (lateral view) of median lobe very similar. However, other features like different armature pattern of the internal sac and left paramere and pronotum conformations easily segregate both species. Moreover the males of *G. iborensis* do not present a tooth on the internal margin of the hind femora. Taking into account the more or less sickle-shaped pattern of median lobe, the new species seems also close to *G. olisipensis* and *G. leoni*. However, in the former species the internal edge of male hind femora is inerm. The new species differ from *G. leoni*, among other features, also by characters of the left paramere, which does not bear any lamellar and membranous scales in the apex (Zaballo, 1998). Adults of the new species described herein lack traces of striae on elytra unlike *G. quartai*, *G. massinissa* (Dieck, 1869), *G. korbi* (Ganglbauer, 1900), *G. julianae* Zaballo, 1989 and *G. montecristoi* Zaballo 2005.

Finally, we can point out that the new species is easily separated from the others of the same genus by the shape of median lobe and the sclerites of the internal sac. The conjugation of aedeagus features plus some characters such as the left paramere and pronotum forms, the elytral microsculpture and the tooth of male hind femora (present) can help in his diagnosis.

FAUNISTIC DATA

Geocharis olisipensis Schatzmayr, 1937

Material examined: Serra de Montejunto (U.T.M. coordinates: 29SMD9737), 25.X.2005, 1♂, 3 ♀♀, 24.XI.2005, 2♂♂, 2♀♀.

Within the genus *Geocharis* this species was the first one described for Portugal (Schatzmayr, 1937) based on two specimens collected near Lisbon. Serrano & Aguiar (2004) after some efforts to locate this species found it in the outskirts of Lisbon (Valejas and Fanhões). The study of some specimens captured in Serra de Montejunto (almost 50 km to north of Lisbon), showed for this species a wider distribution than previously knew (Fig. 11).

Geocharis quartai Serrano & Aguiar, 2004

Material examined: Serra de Montejunto (U.T.M. coordinates: 29SMD9737), 25.X.2005, 1♂, 24.XI.2005, 1♂, 1♀.

A species recently described on the basis of several specimens collected near Alcobaça (Carvalhal), a locality close to Aire e Candeeiros Mountains. As well as the precedent species, the study of some specimens captured in Serra de Montejunto (almost 40 km to south of Alcobaça), showed for this species a wider distribution than previously knew. These captures showed that these two species are syntopic, at least for the Montejunto region (Fig. 11).

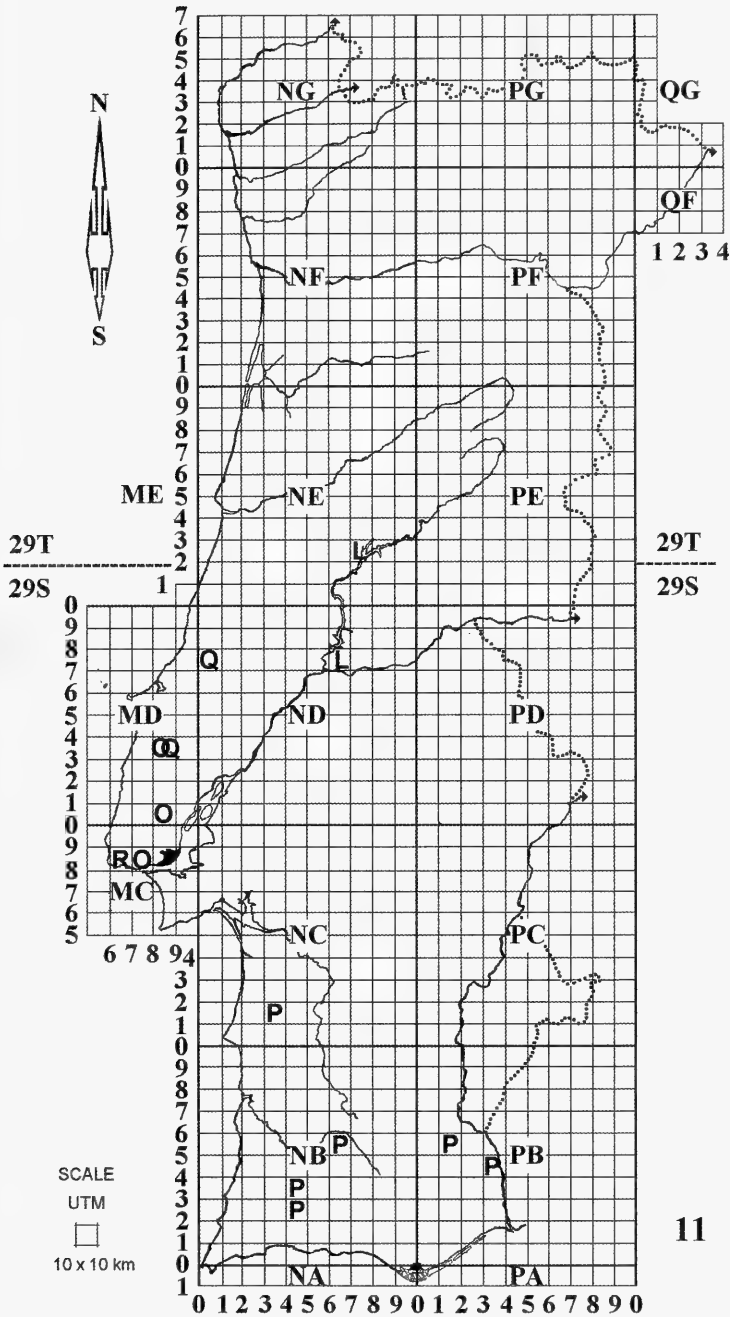


FIG. 11

Distribution in Portugal (U.T.M. 10x10 km coordinates): (R) *G. rodriguessi* n. sp., (O) *G. olisipensis*, (Q) *G. quartau*, (P) *T. paulinoi* and (L) *H. lusitanicus*.

Typhlocharis paulinoi Serrano & Aguiar, 2006

Material examined: Fernão Vaz (U.T.M. coordinates: 29SNB6459), 31.I.2006, 7♂♂, 6♀♀; Altura da Choça (U.T.M. coordinates: 29SNB4732), 22♂♂, 7♀♀; Santa Margarida da Serra (U.T.M. coordinates: 29SNC3515), 14.III.2006, 11♂♂, 8♀♀, 3.IV.2006, 1♀.

Another species recently described to southern regions of Portugal (Algarve Province) (Serrano & Aguiar, 2006b). While the former localities (Fernão Vaz and Altura da Choça) are more or less close to the ones already given (Serrano & Aguiar, *op. cit.*), the latter (Santa Margarida da Serra) showed for this species a wider distribution to north (almost 80 km) than previously tough (Fig. 11).

Hypotyphlus lusitanicus Serrano & Aguiar, 2004

Material examined: Barragem do Cabril (Pedrógão Grande) (U.T.M. coordinates: 29SNE7321), 20.III.2007, 3♀♀.

This remarkable species was found in the centre of Portugal (Aldeia do Mato near Tomar) (Serrano & Aguiar, 2004b). The new locality here given increases considerably the distribution of this species almost far away 60 km to north (Fig. 11).

ECOLOGICAL AND GEOGRAPHICAL CONSIDERATIONS

The new species are endogean, like the others of the genus *Geocharis*, living in the soil at different depths of the B-horizon. Normally, only one species of *Geocharis* occurs at any one locality, however, there are some observed exceptions (see above and Serrano & Aguiar, 2006a). *Geocharis rodriguesi* n. sp. is also syntopic with one new species of the genus *Typhlocharis* (not given here, Serrano & Aguiar, in press).

All the *Geocharis* species herein studied are known from localities that range between the Lisbon region and Aire e Candeeiros Mountains. Curiously despite several field surveys to north of Tejo river at Portugal, only the ones conducted in the western region north of Lisbon allowed the discovery of *Geocharis* species until now. Furthermore, in this region those surveys allowed us also to find and describe two species of the genus *Typhlocharis* (*T. passosi* Serrano & Aguiar, 2005, and *T. bivari* Serrano & Aguiar, 2006), all belonging to the *gomezi* group (Serrano *et al.*, 2005, 2006c). On other regions north of Tejo river at Portugal than the above we found and described one species of *Typhlocharis* near Vila Nova de Foz Côa (*T. fozcoensis* Serrano & Aguiar, 2005) and one species of the genus *Hypotyphlus* (*H. lusitanicus*) near Castelo de Bode dam (Aldeia do Mato, Tomar). Recently we found the latter species at Cabril dam near Pedrógão Grande, a station almost 60 km to north of the previously recorded locality. The precise distribution limits of all these species are difficult to address with no additional data available. Our studies during the last five years confirm that the previous idea that the majority of endogean carabid species are restricted in distribution is not totally certain. For instance the finding of *T. paulinoi* about 80 km far away of his known distribution is a good example of this assumption. Finally we would like point out that *G. rodriguesi* n. sp. was found within the limits of the Parque Natural Sintra-Cascais, a protected area in Portugal included in the "Rede Natura 2000".

KEY TO SPECIES OF *GEOCHARIS* NORTH OF TEJO RIVER (PORTUGAL)

1. Disk of elytra with one or two pairs of setae, one posterior or one median and one posterior. Internal edge of male hind femora inerm. Aedeagus as in figure 26 C and D (in Serrano & Aguiar, 2004a) *G. olisipensis*
- 1'. Disk of elytra with two pairs of setae, one anterior and one posterior. Internal edge of male hind femora inerm or dentate 2
2. Internal edge of male hind femora inerm. Elytra with tegument strongly punctured in the disk, without striae. Aedeagus as in figure 26 A and B (in Serrano & Aguiar, 2004a) *G. quartauí*
- 2'. Internal edge of male hind femora dentate 3
3. Elytra with tegument only punctured near the shoulders, the disk without striae 4
- 3'. Elytra with tegument strongly punctured in the disk, with the presence of superficial striae. Aedeagus as in figure 17 C and D (in Serrano & Aguiar, 2004a) *G. bivari*
4. Aedeagus as in figure 17 A and B (in Serrano & Aguiar, 2004a) *G. fermini*
- 4'. Aedeagus as in figure 9 and 10 (this work) *G. rodriguesi* n. sp.

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REFERENCES

- ANDÚJAR, C., LENCINA, J. L. & SERRANO, J. 2008. *Typhlocharis* Dieck, 1869 (Coleoptera, Carabidae, Anillini): a new species from the Iberian Peninsula, with notes about its relationships and the evolution of the diecki species group. *Zootaxa* 1842: 35-44.
- SCHATZMAYR, A. 1937. Due nuovi Bembidiini anoftalmi della Regione Palearctica. *Pubblicazione del Museo Entomologico "Pietro Rossi" Duino* 1: 327-328.
- SERRANO, J. 2003. Catálogo de los Carabidae (Coleoptera) de la Península Ibérica. *Monografías S.E.A.* 9: 5-130.
- SERRANO, A. R. M. & AGUIAR, C. A. S. 2004a. Three new species of the genus *Geocharis* Ehlers, 1883 from Portugal (Coleoptera, Carabidae). *Graellsia* 60 (1): 71-80.
- SERRANO, A. R. M. & AGUIAR, C. A. S. 2004b. A remarkable new endogean species of the genus *Hypotyphlus* Jeannel (Coleoptera: Carabidae) from Portugal. *The Coleopterists Bulletin* 58 (1): 111-117.
- SERRANO, A. R. M. & AGUIAR, C. A. S. 2006a. New species and new data on the genus *Geocharis* Ehlers, 1883 (Coleoptera: Carabidae) from Portugal. *Annales de la Société entomologique de France* (n.s.) 42 (1): 79-89.
- SERRANO, A. R. M. & AGUIAR, C. A. S. 2006b. Two new species of *Typhlocharis* Dieck, 1869 of the *silvanoides* group from Portugal (Coleoptera, Carabidae). *Animal Biodiversity and Conservation* 29 (1): 9-18.
- SERRANO, A. R. M. & AGUIAR, C. A. S. 2006c. Two new species of *Typhlocharis* Dieck, 1869 (Coleoptera, Carabidae) from Portugal and notes on the related species. *Deutsche entomologische Zeitschrift* 53 (2): 223-234.
- SERRANO, A. R. M. & AGUIAR, C. A. S. in press. Two new species of *Typhlocharis* Dieck, 1869 (Coleoptera: Carabidae) from Portugal: description and notes on the related species. *Graellsia*.

- SERRANO, A. R. M., AGUIAR, C. A. S. & PROENÇA, S. J. R. 2005. Two new species of *Typhlocharis* Dieck of the gomezi species group from Portugal (Coleoptera: Carabidae). *The Coleopterists Bulletin* 59 (2): 239-249.
- SOKOLOV, I., CARLTON, C. & CORNELL, J. F. 2004. Review of *Anillinus*, with descriptions of 17 new species and a key to soil and litter species (Coleoptera: Carabidae: Trechinae: Bembidiini). *The Coleopterists Bulletin* 58 (2): 185-233.
- ZABALLOS, J. P. 1998. Interesante nueva especie de *Geocharis* Ehlers, 1883 de España (Coleoptera, Caraboidea, Trechidae, Anillini). *Graellsia* 54: 19-24.
- ZABALLOS, J. P. 2005. Los *Geocharis* Ehlers, 1883 de Marruecos y Cádiz (España) (Coleoptera, Carabidae, Trechinae, Anillini). *Graellsia* 61 (1): 61-81.
- ZABALLOS, J. P. & JEANNE, C., 1987. Etude systématique du genre *Geocharis* (Col. Trechidae Anillini) et description d'une nouvelle espèce. *Bulletin de la Société linnéenne de Bordeaux* 15 (2): 81-92.

REVUE SUISSE DE ZOOLOGIE

Tome 115 — Fascicule 4

	Pages
SCHÄTTI, Beat & TRAPE, Jean-François. <i>Bamanophis</i> , a new genus for the West African colubrid <i>Periops dorri</i> Lataste, 1888 (Reptilia: Squamata: Colubrinae)	595-615
YANG, Ding. Two new yellow-legged species of <i>Hybos</i> Meigen from Hainan, China (Diptera, Hybotidae)	617-622
MAHUNKA, Sándor. More oribatids from Thailand (Acari: Oribatida)	623-649
CASCIOTTA, Jorge & ALMIRÓN, Adriana. <i>Crenicichla tesay</i> , a new species of cichlid (Perciformes: Labroidei) from the río Iguazú basin in Argentina	651-660
MERZ, Bernhard. Two new species of Chloropidae (Diptera) from Switzerland	661-676
SCHUCHERT, Peter. The European athecate hydroids and their medusae (Hydrozoa, Cnidaria): Filifera Part 4	677-757
BOLZERN, Angelo, HÄNGGI, Ambros & BURCKHARDT, Daniel. Funnel web spiders from Sardinia: Taxonomical notes on some <i>Tegenaria</i> and <i>Malthonica</i> spp. (Araneae: Agelenidae)	759-778
SERRANO, Artur R. M. & AGUIAR, Carlos A. S. A new species of the genus <i>Geocharis</i> Ehlers, 1883 and some faunistic data on endogean carabids from Portugal (Coleoptera: Carabidae)	779-788

REVUE SUISSE DE ZOOLOGIE

Volume 115 — Number 4

Pages

SCHÄTTI, Beat & TRAPE, Jean-François. <i>Bamanophis</i> , a new genus for the West African colubrid <i>Periops dorri</i> Lataste, 1888 (Reptilia: Squamata: Colubrinae)	595-615
YANG, Ding. Two new yellow-legged species of <i>Hybos</i> Meigen from Hainan, China (Diptera, Hybotidae)	617-622
MAHUNKA, Sándor. More oribatids from Thailand (Acari: Oribatida)	623-649
CASCIOTTA, Jorge & ALMIRÓN, Adriana. <i>Crenicichla tesay</i> , a new species of cichlid (Perciformes: Labroidei) from the río Iguazú basin in Argentina	651-660
MERZ, Bernhard. Two new species of Chloropidae (Diptera) from Switzerland	661-676
SCHUCHERT, Peter. The European athecate hydroids and their medusae (Hydrozoa, Cnidaria): Filifera Part 4	677-757
BOLZERN, Angelo, HÄNGGI, Ambros & BURCKHARDT, Daniel. Funnel web spiders from Sardinia: Taxonomical notes on some <i>Tegenaria</i> and <i>Malthonica</i> spp. (Araneae: Agelenidae)	759-778
SERRANO, Artur R. M. & AGUIAR, Carlos A. S. A new species of the genus <i>Geocharis</i> Ehlers, 1883 and some faunistic data on endogean carabids from Portugal (Coleoptera: Carabidae)	779-788

Indexed in CURRENT CONTENTS, SCIENCE CITATION INDEX

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